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# Drift Prospecting and Quaternary Geology in the Atholville and Charlo Map Areas, Northern New Brunswick

Marni Lynne Dickson

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December, 2002

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# DRIFT PROSPECTING AND QUATERNARY GEOLOGY IN THE ATHOLVILLE AND CHARLO MAP AREAS, NORTHERN NEW BRUNSWICK

by

**Marni Lynne Dickson**

B.A., M$^{c}$ Master University, 1996

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

**Master of Science**

in the Academic Unit of
Geology

Supervisor: B. E. Broster, Ph.D., Geology

Examining Board: D. Lentz, Ph.D., Geology, Chair

D. Black, Ph.D., Anthropology

This thesis is accepted

.....
Dean of Graduate Studies

THE UNIVERSITY OF NEW BRUNSWICK

February, 2001

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# ABSTRACT

Glacigenic sediments and landforms indicate that the Atholville (NTS 21 O/15) and Charlo (NTS 21 O/16) map areas of northeastern New Brunswick experienced a complex style of glaciation during the Late Wisconsinan. Three major directions of ice-movement were indicated by outcrop striae and streamlined landforms: (1) an early southeastward (120° - 160°), (2) eastward (070° - 110°), and (3) a final northeastward (010° - 060°) direction.

Regional and detailed surficial mapping and till sampling was undertaken to investigate clast and geochemical dispersal patterns from known Cu-Mo mineral occurrences associated with base-metal porphyry-skarns in the Popelogan Lake area. The results were also used to identify other buried and previously unknown sources of mineralization in the area. Sampling was conducted on a detailed scale (50 to 100 m spacing) in the area of the occurrences and on a 2 km grid in the remainder of the study area. A total of 171 clast samples and 328 matrix geochemical samples were collected from the till. The -63μm (silt+clay) size fraction of the till matrix samples was analyzed for a total of 39 different elements by Instrumental Neutron Activation Analysis (INAA) and Atomic Absorption Spectrometry (AAS). Dispersal patterns were typically elongated over a distance of 5 km for clasts and 2 km for elemental concentrations; several patterns indicate the influence of two ice-flow directions.

A total of 109 humus samples were collected over the porphyry-skarn occurrences and analyses were compared with till matrix samples taken at the same location. Concentrations of Ag, Cd, Hg, Mo, Pb, and Zn in humus are higher than those in till at the same site, as a result of hydromorphic and/or biogeochemical factors. While forming a larger target than that recognized by the till analysis, the humus elemental concentration patterns did not delineate a point source similar to the typical elongated or wedge-shaped till dispersal patterns.

# RÉSUMÉ

Les reliefs et les sédiments glaciogéniques révèlent que les secteurs cartographiques d'Atholville (SNRC 21 O/15) et de Charlo (SNRC 21 O/16) dans le Nord-Est du Nouveau-Brunswick ont connu un style complexe de glaciation pendant le Wisconsinien tardif. Les stries des affleurements et les reliefs laminaires révèlent trois principales directions de déplacement des glaces : 1) un déplacement précoce vers le sud-est (120° - 160°), 2) un déplacement vers l'est (70° - 110°) et 3) un déplacement final vers le nord-est (10° - 60°).

On a réalisé des travaux régionaux détaillés de cartographie de surface et d'échantillonnage de till pour étudier les modes de dispersion des clastes et des éléments géochimiques à partir de venues minérales connues de Cu-Mo associées à des skarns porphyriques de métaux communs dans le secteur du lac Popelogan. Les résultats ont également permis de repérer d'autres sources de minéralisation enfouies et auparavant inconnues dans la région. L'échantillonnage a été réalisé à une échelle détaillée (selon un espacement de 50 à 100 m) dans la zone des venues et selon un maillage de deux kilomètres dans le reste du secteur d'étude. Au total, 171 échantillons de clastes et 328 échantillons géochimiques de gangue ont été prélevés du till. On a soumis la fraction d'une dimension de -63µm (limon plus argile) de gangue du till à des analyses par activation neutronique non destructrice (ANND) et par spectrométrie d'absorption atomique (SAA) pour vérifier la présence de 39 éléments différents. Les modes de dispersion s'étiraient généralement sur une distance de cinq kilomètres dans le cas des clastes et de deux kilomètres dans le cas des concentrations d'éléments; plusieurs tracés révèlent l'influence de deux directions d'écoulement glaciaire.

On a prélevé une quantité totale de 109 échantillons d'humus au-dessus des venues de skarns porphyriques et on en a réalisé des analyses comparatives avec les échantillons de gangue de till prélevés au même endroit. Les concentrations d'Ag, de Cd, de Hg, de Mo, de Pb et de Zn à l'intérieur de l'humus sont supérieures à celles à l'intérieur du till au même endroit, en raison de facteurs hydromorphes ou biogéochimiques. Même si les modes de concentration des éléments dans l'humus forment un objectif plus vaste que celui défini par l'analyse du till, ils n'ont pas délimité une source ponctuelle semblable aux tracés de dispersion du till généralement allongés ou cunéiformes.

# ACKNOWLEDGEMENTS

Thanks to my supervisor, Bruce Broster, for being a mentor and for giving me two words to live by: 'Occam's razor'. Also, to Mike Parkhill for affording me opportunities and experience that will benefit me for a lifetime. Thanks also to my supervisory committee and reviewers for their help in enhancing the quality of my work.

Many others deserve thanks for helping me see this thesis through to completion. The list would be long and I would not want to leave anyone out, so I will simply extend my gratitude to all. Each person knows how they have helped me, whether it has been scholastically or emotionally, and I appreciate everyone's efforts.

I would especially like to thank my family for the support and encouragement they have provided me through many years of schooling.

Most notably, I want to thank Seàn and dedicate this thesis to him - you picked me up when I fell and taught me that attitude is everything.

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Vita

# CHAPTER 1

# INTRODUCTION

Tills are first derivative sediments of bedrock (Shilts, 1976) and therefore, retain some of the lithological and geochemical characteristics of their original source. The abundances of source rock components in till are commonly used to define distinctive patterns of component concentrations, so-called dispersal fans or trains (DiLabio and Coker, 1987), that decrease immediately down-glacier of the bedrock source. These dispersal patterns, combined with a thorough understanding of the processes and mechanisms of glacial systems, enables the use of till as a source of information for mineral exploration in glaciated terrains.

The interpretation of dispersal trains can often be confused by multiple ice-flow directions, topographic influence, or post-depositional weathering. This is particularly problematic in sub-alpine terrains such as the Appalachian region of eastern Canada. Such areas are characterized by highly variable terrain resulting from glaciation associated with growth of individual cirque glaciers and their coalescence into larger valley glaciers or ice sheets (Broster and Huntley, 1995).

Northern New Brunswick is typical of glaciated Appalachian terrains. In addition, the bedrock has been weathered, prior to glaciation, to depths of up to 26 m (Veillette and Nixon, 1982). This weathered material has been incorporated into the overlying tills that locally exceed 4 m in thickness behind obstructions and along valleys.

Northern New Brunswick has experienced multiple ice-flow events, resulting in the deposition of a unit of till that has subsequently been deeply weathered. It is also an area of known sulphide mineralization associated with Devonian base-metal (Cu, Pb, Zn, Ag, and Mo) porphyry and skarn deposits. As such, dispersal patterns produced from these occurrences can be examined to determine the effects of multiple ice-flow directions and weathering.

## 1.1 Purpose and Scope

Surficial mapping and sampling in the study area was co-ordinated by M. A. Parkhill of the New Brunswick Department of Natural Resources and Energy and was conducted as part of the Restigouche Project - Phase 3. The primary focus of the Quaternary mapping and sampling portion of the project was to delineate glacial dispersal patterns of clast and matrix components in till originating from known mineral occurrences and their host rocks. The length and direction of the clast and geochemical dispersal trains were used to 'model' glacial dispersal from unknown sources.

A second objective was to determine how well ice-flow indicators, including striae, grooves, rat-tails, streamlined ridges, and drumlinoid features, record ice-flow direction and debris transport direction in the study area during glaciation.

A third objective of the study was to determine the effectiveness of humus, relative to till, as a sampling medium for delineating geochemical dispersal patterns. Geochemical data of till and humus samples taken at the same site were compared by statistical correlation and plotted to compare dispersal patterns.

## 1.2 Location and Access

The study area is located in north-central New Brunswick , Canada (Figure 1.1), 20 km south-east of the city of Campbellton. The area is bounded by longitudes 66°30' and 66°15' W and latitudes 47°44' and 48°00'N and comprises the junction of four National Topographic Series map sheets: Atholville (21 0/15), Charlo (21 O/16), Upsalquitch Forks (21 O/10), and Tetagouche Lakes (21 O/9)(Figure 1.2). Access to the study area is provided by Provincial Highway Route 11 and Route 134, which transect the northwest corner of the area (Figure 1.2). An extensive network of secondary and logging roads provide access to the interior by automobile, whereas cut-lines, skidder, game, and snowmobile trails provide additional access by all-terrain vehicle and foot.

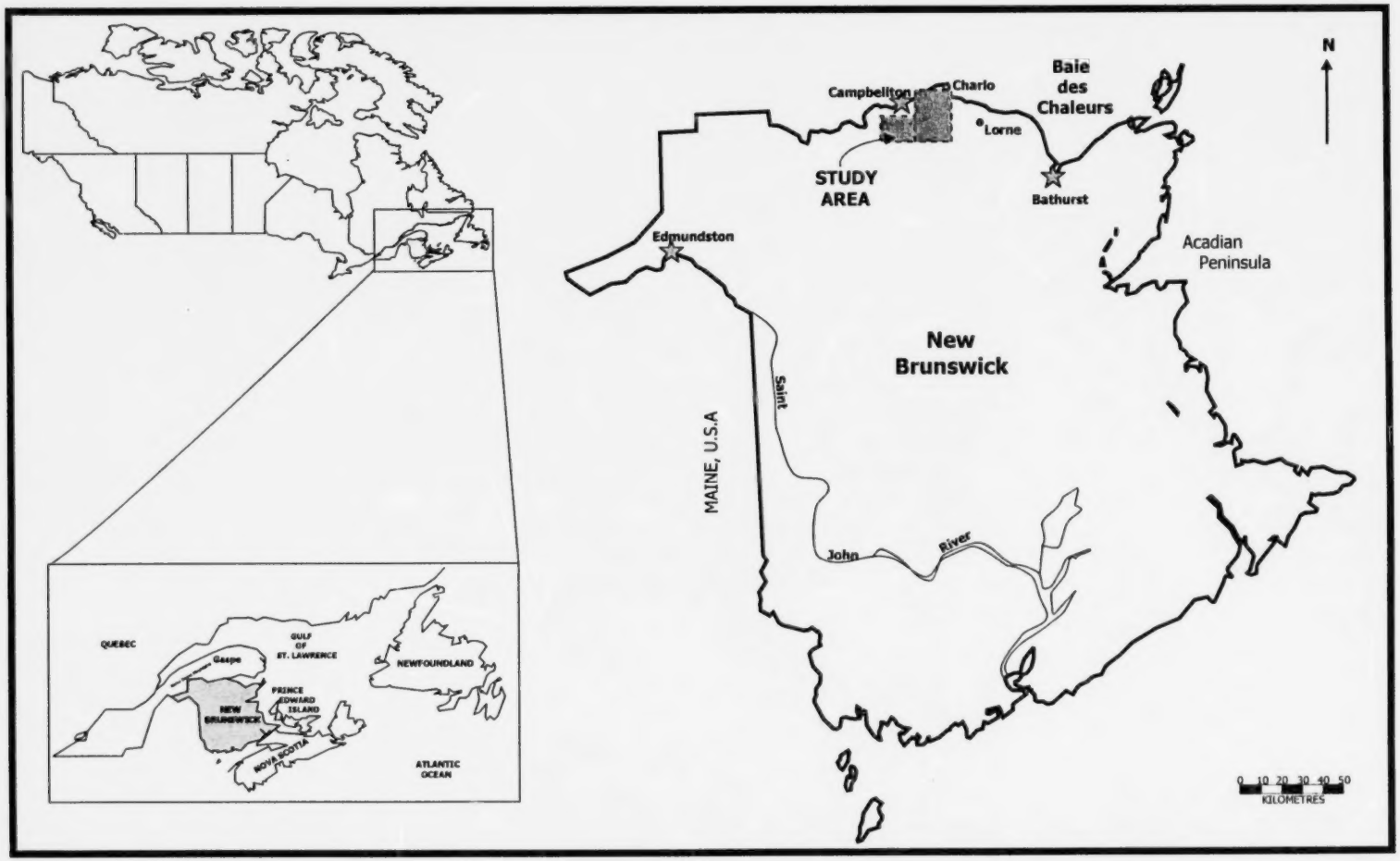



Figure 1.1: Location of study area.

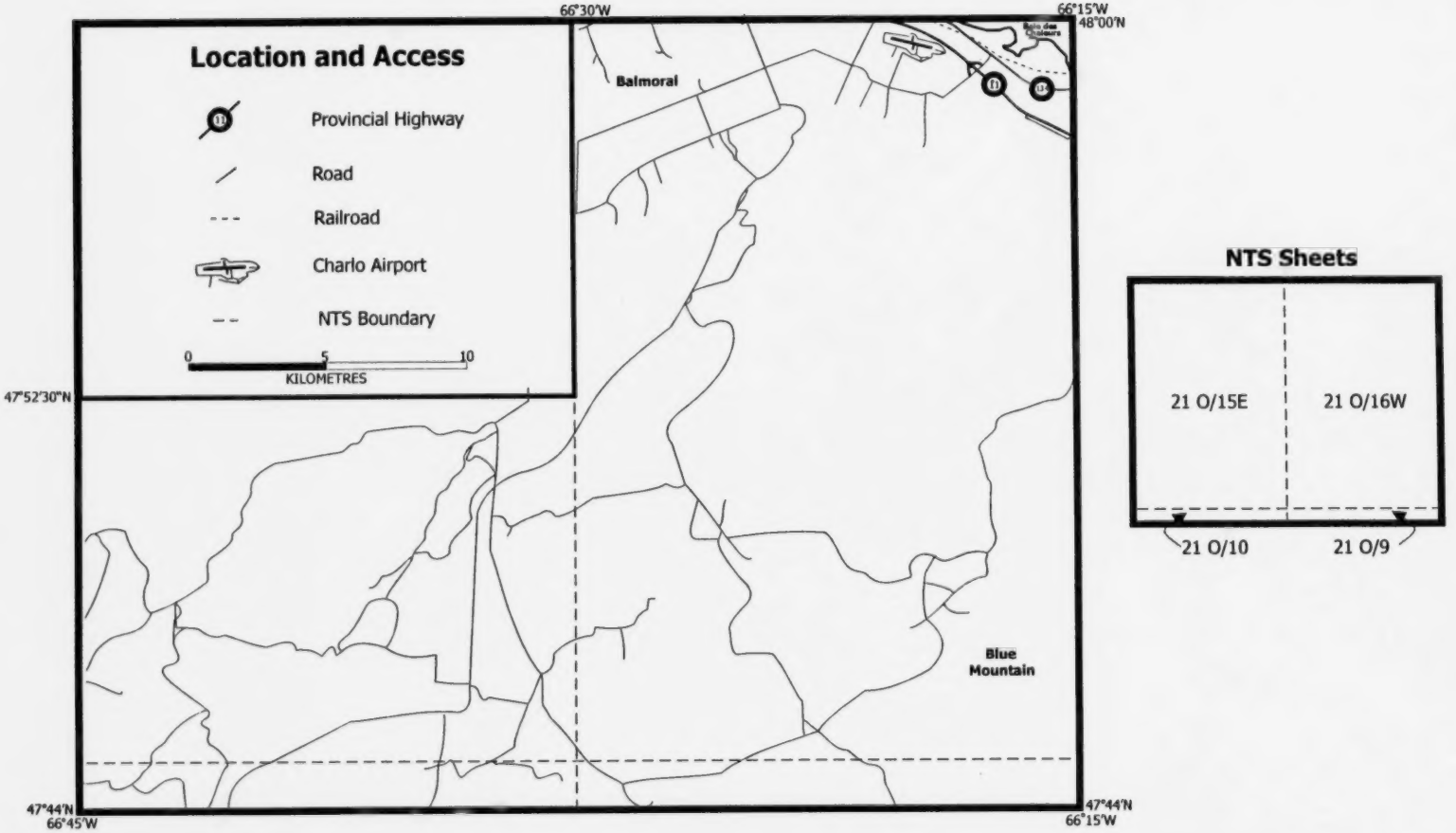



Figure 1.2: Location of the study area with major access routes.

## 1.4 Physiography

New Brunswick is located in the Appalachian region of Canada (Bostock, 1970). The province is divided into six main physiographic regions, based on tectonostratigraphic zones and structural elements (Figure 1.3), with each region subdivided into smaller physiographic elements (Bostock, 1970; Rampton et al., 1984). The study area is situated in the Chaleurs Uplands physiographic region and encompasses two of its subdivisions: the Jacquet Plateau and the Chaleur Coastal Plain (Figure 1.3). The Jacquet Plateau is a low, undulating surface with elevations generally less than 300 m, although a few ridges (e.g., Blue Mountain) reach elevations of 600 m. Generally, the plateau slopes gently to the north and east. The Chaleur Coastal Plain, bordering the Baie des Chaleurs, is a gently undulating, sloping plain, generally below 70 m elevation.

## 1.5 Drainage

Drainage in the area is to the east and northeast, towards the Baie des Chaleurs, via the deeply incised, V-shaped valleys of the Charlo, South Charlo, and Benjamin River systems (Figure 1.4). Drainage patterns are parallel to sub-parallel, following structural trends in the area (Figure 1.5; Rampton et al., 1984). Lakes occupy topographic depressions related to the structural trend of the bedrock. Poorly drained areas are mostly found in broad depressions in the southeast portion of the study area.

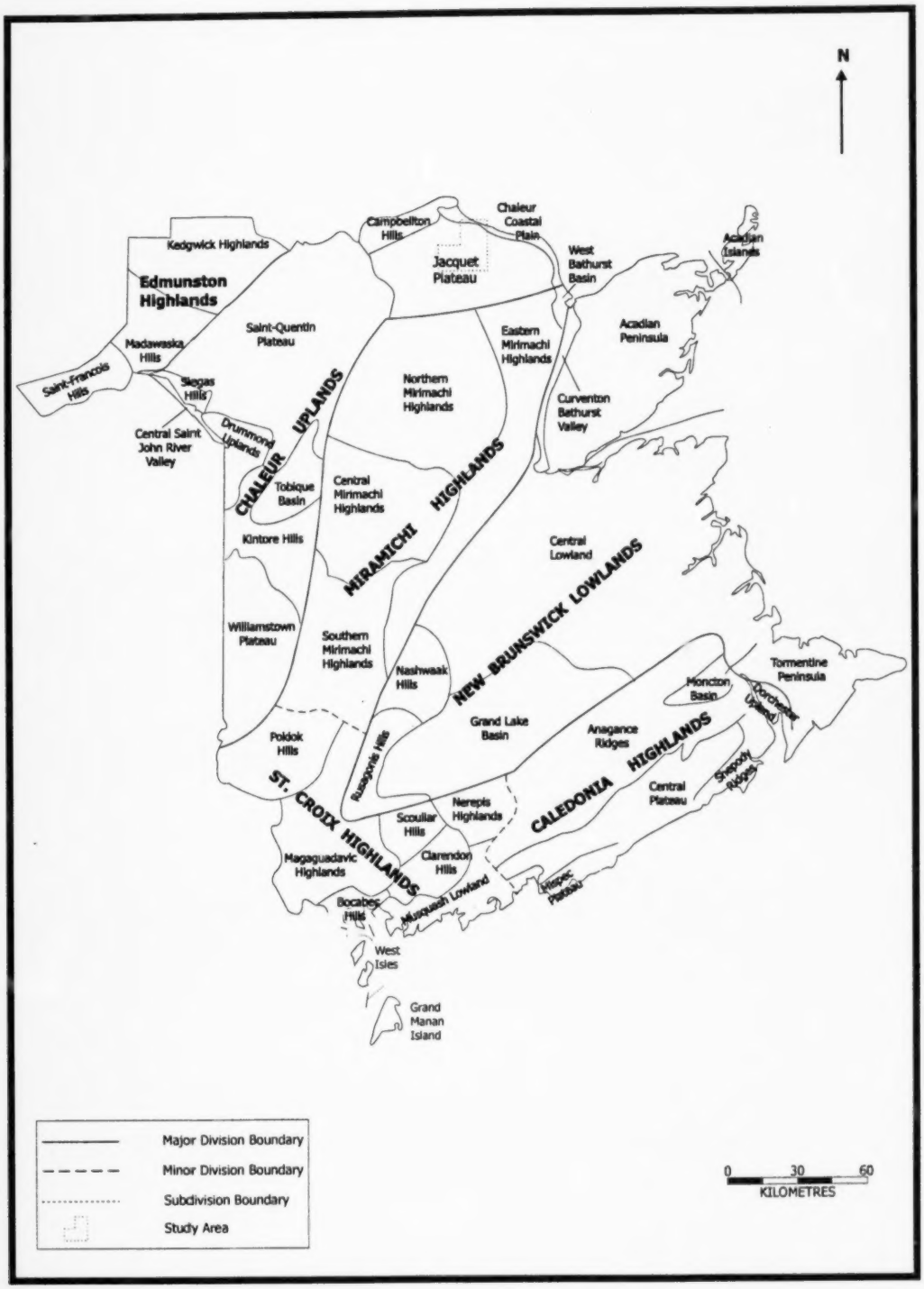



Figure 1.3: Physiographic regions of New Brunswick (after Rampton et al., 1984)

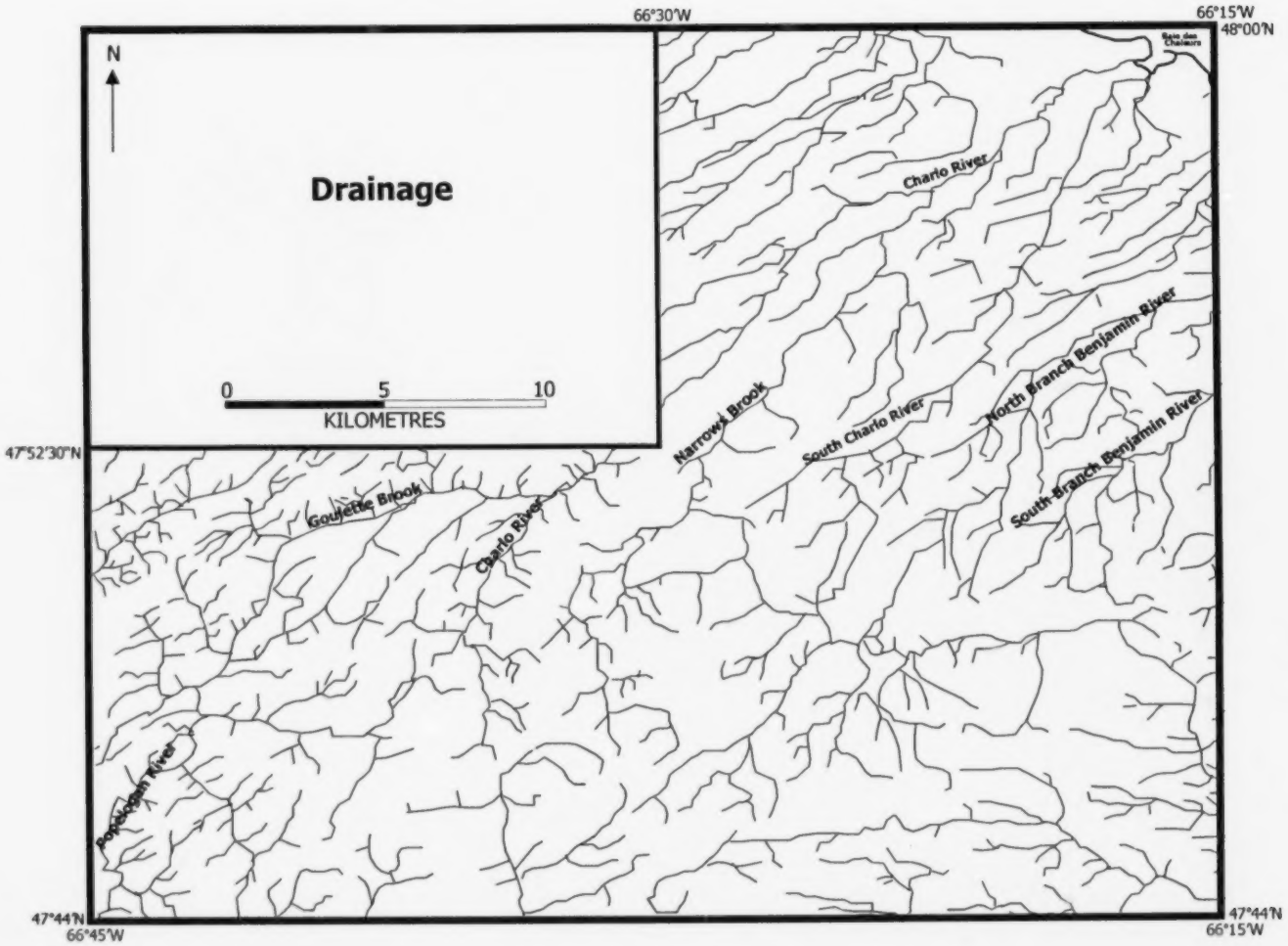



Figure 1.4: Drainage systems of the study area.

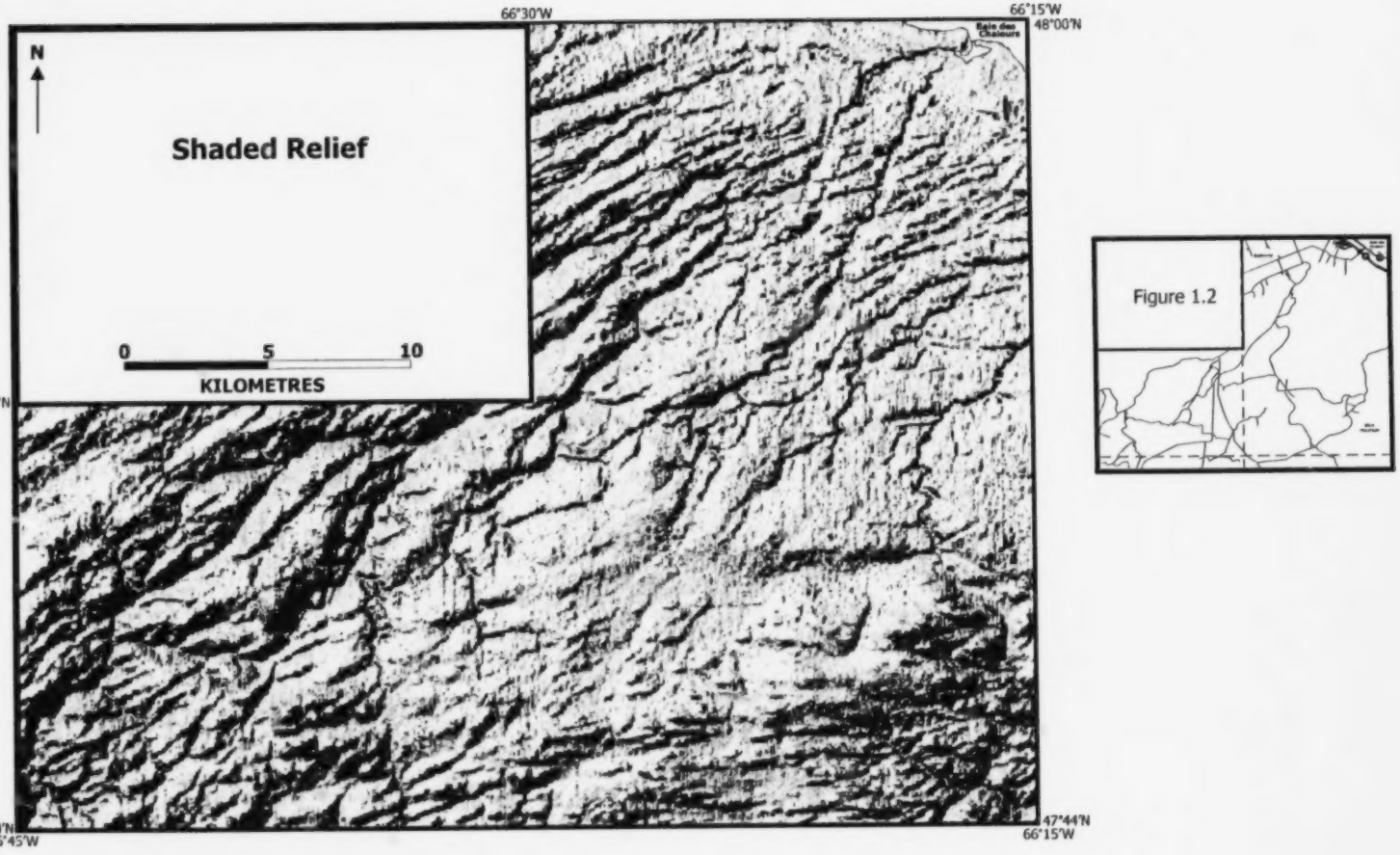



Figure 1.5: Shaded relief depicting the topography of the study area.

# CHAPTER 2

# METHODOLOGY

## 2.1 Field Methods

Sampling in the Charlo (21 O/16W) and Tetagouche Lakes (O/9E) map areas was conducted in the 1999 field season (Figures 2.1, 2.2). Detailed overburden sampling in the area of the Popelogan porphyry-skarn occurrences (21 O/15E: Figure 2.2) was completed in the 1998 field season. A total of 171 samples were collected during the 1998 and 1999 field seasons (Figures 2.1, 2.2: Appendix I). An additional 157 samples, archived from previous surveys (Lamothe, 1986; Pronk, 1986; Pronk and Parkhill, 1988: Figures 2.3, 2.4; Appendix I), were obtained for re-analysis. Sample locations were identified, using topographic maps (1:50 000 and 1: 20 000) and aerial photos (1:35 000 and 1:12 500), to provide an average sampling density of one sample per four square kilometres. Detailed sampling in the area of the Popelogan porphyry-skarn occurrences was conducted at a density of 50 to 100 m spacing (Figure 2.2) to delineate clast and geochemical dispersal patterns from known base-metal mineralized bedrock sources.

Samples were collected from hand-dug pits, road cuts, and natural exposures. Sample pits were approximately 0.5 m in diameter and ranged in depth from 0.2 to 0.8 m. Approximately 3 to 5 kg of till matrix was collected from the C- horizon for geochemical analysis. Basal till, as defined by Dreimanis (1976), was the desired sample medium; however, ablation till (Dreimanis, 1976) was sampled where basal till could not be found within a 100 m radius of the designated sample site. Humus samples were taken at 109 sites in the area of the Popelogan porphyry-skarn occurrences (21 O/15E) to examine the effectiveness of this medium, relative to till, in defining geochemical dispersal patterns. Samples of approximately 1 kg were collected by hand and stored in paper bags. Field duplicates of both mediums were collected, at random, to evaluate the precision of the sampling procedure. From 4 to 100 pebble-sized ( 2 - 10 cm diameter) clasts were collected from

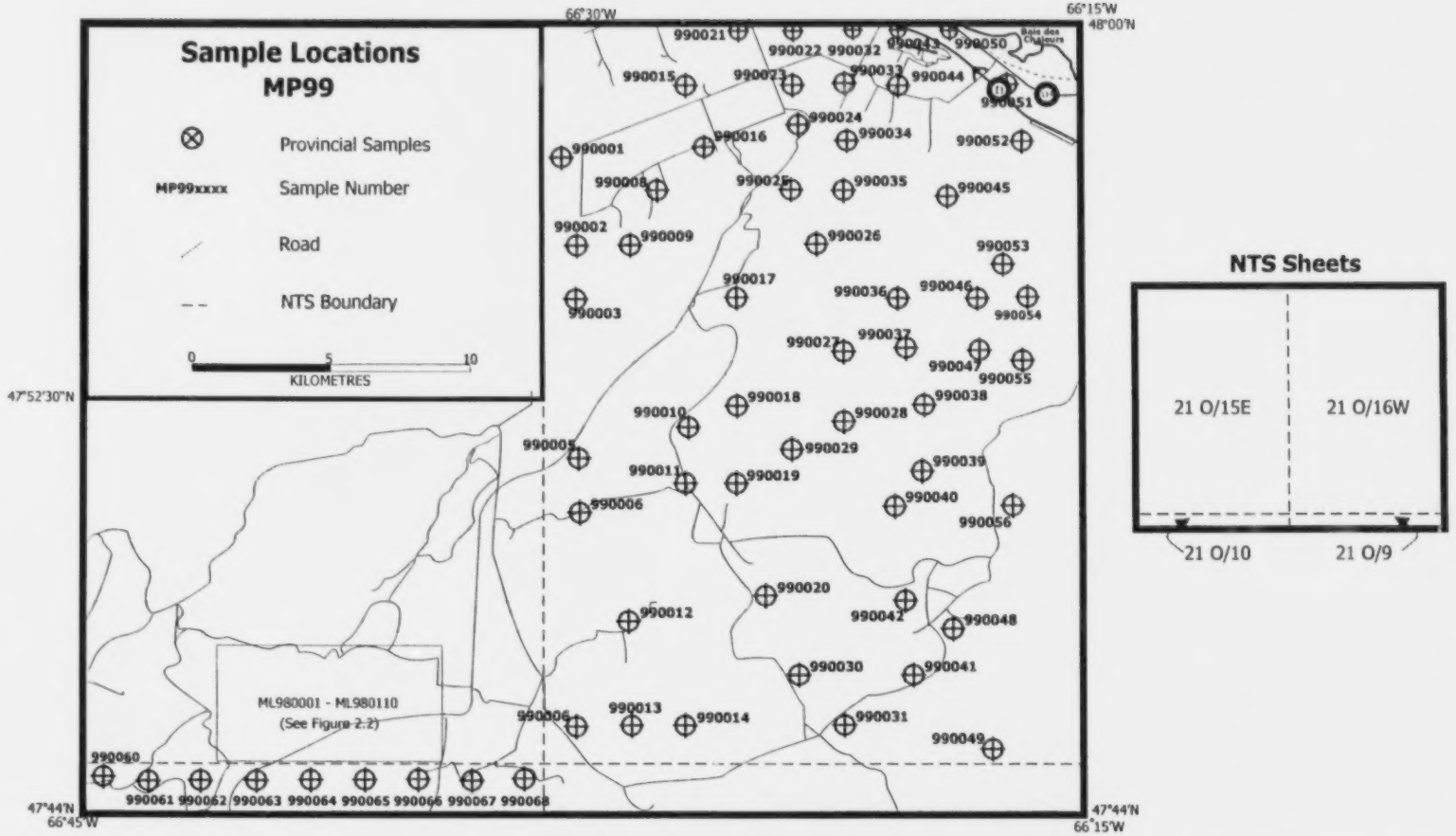



Figure 2.1: Sample site locations of till matrix and clast samples collected during the 1999 field season. Location coordinates are presented in Appendix I as MP990001 - MP990068

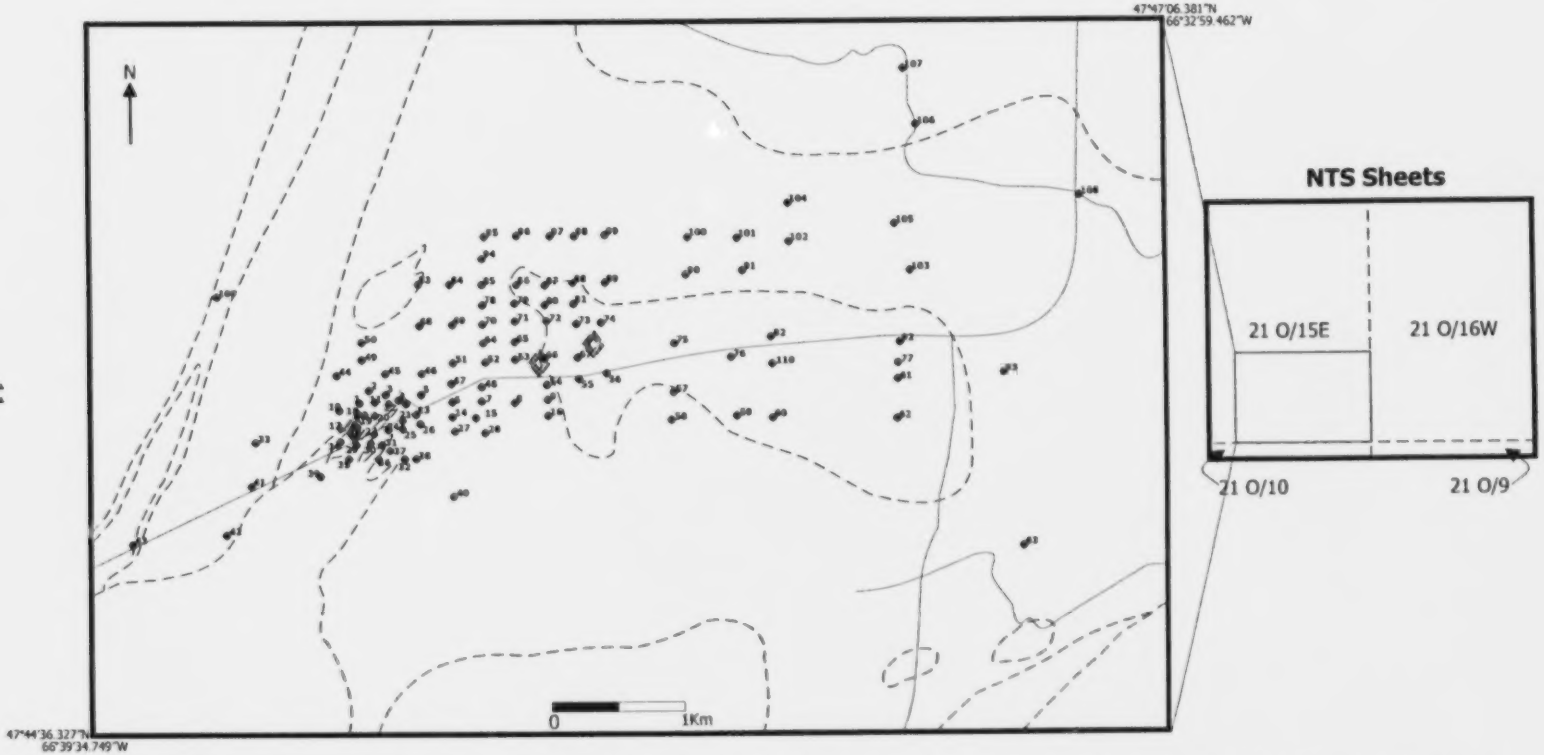



Figure 2.2: Till and humus sample site locations in the area of the Popelogan porphyry-skarn occurrences (21 O/15E). Location co-ordinates are presented in Appendix I as ML980001 - ML980110. Roads are indicated by solid lines, bedrock contacts (Figure 3.2) by dashed lines, and mineral occurrences (Figure 3.3) by diamond shape.

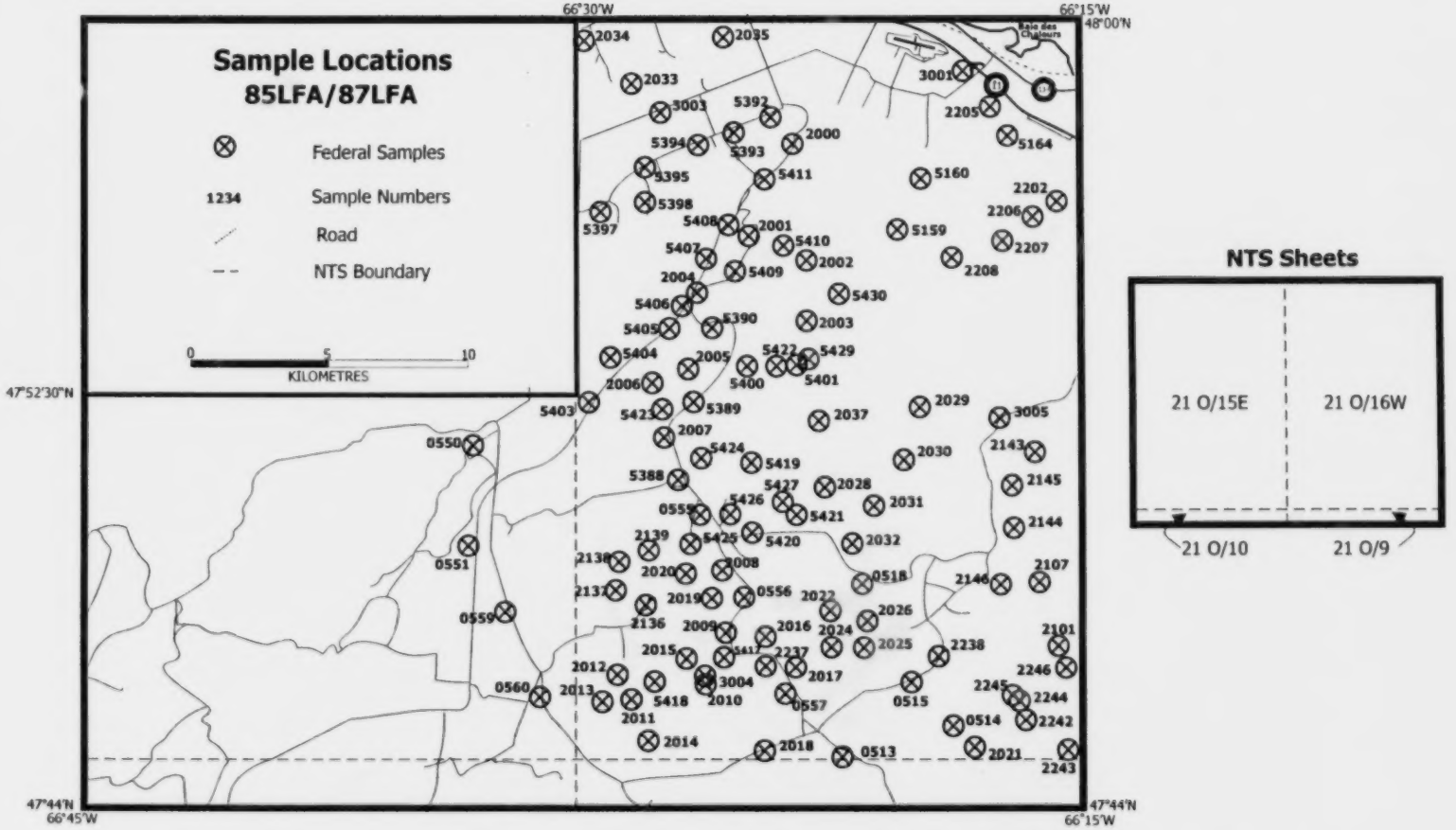



Figure 2.3: Sample site locations of federal survey samples collected during previous studies and reanalyzed for this study. Location coordinates are presented in Appendix I with the prefix 85LFA for samples 0513 -0560 and 87LFA for the remaining samples.

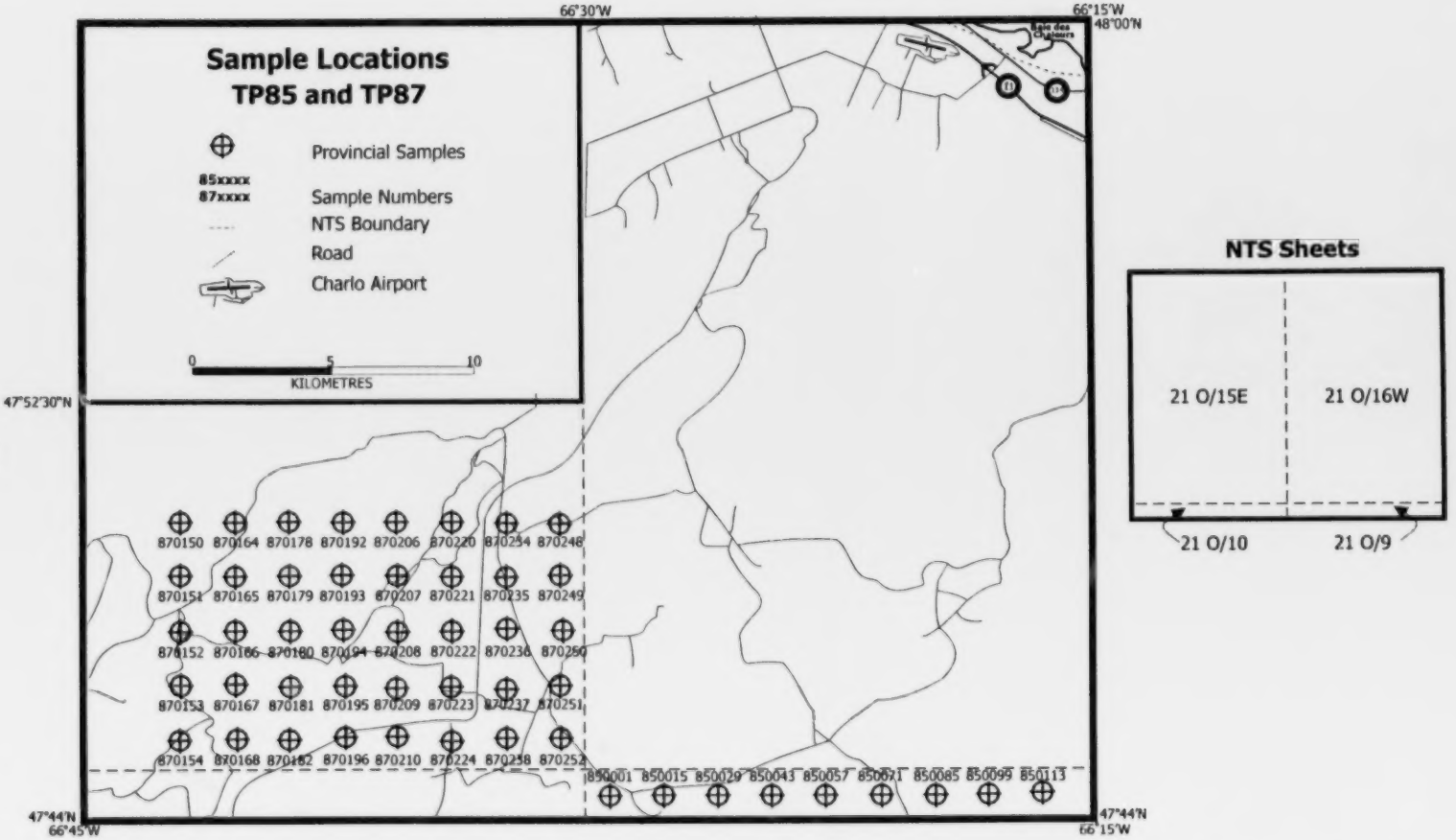



Figure 2.4: Sample site locations of provincial samples collected during previous studies and reanalyzed for this study. Location coordinates are presented in Appendix I with the prefix TP-.

the C-horizon at each sample site for lithological identification. Fragments of larger clasts were included to avoid any sampling bias. A detailed log, including the soil profile, till texture and consistency, local topography, and vegetation was recorded at each site (Appendix II).

Surficial mapping of the study area was carried out during the 1999 field season. Mapping involved traversing roads and trails, examining exposures, and excavating small pits at 100 to 500 m intervals to examine the C-horizon. Ice-flow indicators (striae, grooves, and rat-tails) were recorded from bedrock outcrops encountered during the sampling and mapping program.

## 2.2 Laboratory Methods

Each till sample was oven-dried, sieved, and split to obtain both the -2mm and -63μm grain size fractions for analysis. The -63μm (silt+clay) size fraction of the 328 samples was analyzed by Atomic Absorption Spectrometry (AAS) (Appendix IV-i) and Instrumental Neutron Activation Analysis (INAA) (Appendix IV-ii) for a total of 39 base metals, and other trace elements. Humus samples were air dried, sieved to -80 mesh (177μm) and analyzed by INAA and AAS for the same suite of elements, as well as loss on ignition (LOI) (Appendix IV-iii, IV-iv). Precision and accuracy of all analytical procedures were evaluated by including lab standards and sample splits with the sample suite (Appendix V).

Exactly 100g of the –2mm grain size fraction was used for granulometric analysis. The modified hydrometer method (cf. Bouyoucos, 1962) was used to determine the relative proportions of clay, silt, and sand in each sample (Appendix II).

Clasts collected from the C-horizon of each sample site were broken to obtain a fresh surface. The pebble lithology was examined, with the aid of a hand lens and microscope, and compared to a reference suite of bedrock samples. The clasts were categorized based on type, formation and group, and the relative proportions were determined for each site (Appendix III). Pebbles were also examined for mineralization to detect clast dispersal trains from known and unknown mineral occurrences.

## 2.3 Statistical Methods

Geochemical and lithological analyses were compiled in spreadsheet form and descriptive statistics were performed using Corel® Quattro Pro 9 (Appendix VII). These data were also gridded and contoured using Surfer® 6.01 (Appendix VI). Biased or distorted contours resulting from the irregular shape of the study area and the spacing of samples were alleviated by the use of the Kriging geostatistical method in Surfer® 6.01.

Spearman's rank correlation analysis was performed on the till and humus geochemical data using the Statistical Package for Social Sciences (SPSS 10 for Windows®; Appendix VI). This non-parametric, multivariate analysis was used to determine the covariance of till and humus components.

# CHAPTER 3

# PREVIOUS WORK

## 3.1 Glacial Studies

### 3.1.1. Glacial History of Northern New Brunswick

Surficial studies of the province began in the late 1800s with the work of Matthew (1872, 1879) and Chalmers (1885). Prior to 1884, most studies regarding the glaciation of New Brunswick were confined to the southern half of the province where erosional features (striae and drumlins) indicated a south to southeasterly direction of ice-movement. At that time it was assumed that this was the general ice-movement for the entire province. Subsequently, Chalmers (1885) concentrated his studies in northern New Brunswick and demonstrated that ice-movement there had been towards the east and the north. He suggested that the divergent flow patterns between the northern and southern parts of the province indicated the prior existence of an ice divide situated at the watershed divide for the Saint John River, and the prior existence of a regional ice system, consisting of a number of smaller local ice caps (Chalmers, 1885).

Chalmers (1886) suggested that ice to the north, west, and south of the Baie des Chaleurs (Figure 1.1) flowed down slope into the bay and that south of the bay, ice moved eastward and northward across the Jacquet Plateau, irrespective of topography, toward the Baie des Chaleurs. This ice, south of the bay, coalesced with ice moving down the Restigouche, Nouvelle, and Cascapedia valleys (northwestern New Brunswick and Quebec), forming a local ice cap at the western end of the Baie des Chaleurs basin (Chalmers, 1886).

Rampton et al. (1984) divided the Late Wisconsinan glacial period of New Brunswick into five distinct ice-flow phases: 1) Chignecto (15-18 ka.); 2) Bantalor (13.3-13 ka.); 3) Millville/Dungarvon (12.7 ka.); 4) Plaster Rock (12.4-12 ka.); and 5) Chaleurs (12.4 ka.). Each phase is distinguished by the relative influence of local ice domes and the ice-flow patterns they

produced throughout the province. The chronology of each event is based upon both radiocarbon dating of organic materials found in glacigenic sediments and cross-cutting striae relationships (Rampton et al., 1984).

3.1.1.(i) - Chignecto Phase

The Chignecto phase marks the growth and retreat of the Escuminac Ice Centre, off the north shore of Prince Edward Island (Figure 3.1). As this ice centre expanded it flowed northwestward across the Acadian Peninsula and southeastward down Chignecto Bay toward the Bay of Fundy (Rampton et al., 1984). Ice flow patterns indicate that a second ice centre, the Gaspereau Ice Centre, also existed during this glacial episode (Figure 3.1). Ice flowing from the eastern and northern flanks of the Gaspereau Ice Cap was diverted north, down the Curventon-Bathurst Valley, by Escuminac ice (Rampton et al., 1984). Ice centres in the Notre Dame Mountains (Quebec/Gaspésie) were also active during this time, flowing eastward down the Baie des Chaleurs (Figure 3.1). These ice centres, along with the North Maine Ice Divide prevented the incursion of Laurentide ice from the northwest (Rampton et al., 1984).

3.1.1.(ii) Bantalor Phase

Several flow patterns were initiated and interacted with each other during the Bantalor maximum. Ice originating from the North Maine–Notre Dame Ice Divide complex flowed eastward across the Jacquet Plateau (Jacquet flow pattern) and down the Baie des Chaleurs (Baie des Chaleurs flow pattern of Rampton et al. (1984; Figure 3.1). Ice from the Gaspereau Ice Centre, with some contribution from the North Maine Ice Divide to the west, continued to flow down the Curventon-Bathurst Valley, terminating in the Baie des Chaleurs (Rampton et al., 1984).

Rampton et al. (1984) postulated that a suture formed in the contact zone between the Jacquet and Baie des Chaleurs flow patterns. Meltwater flowing east from these ice lobes formed an interlobate feature comprising ice-contact deposits, ablation till, outwash, and glaciomarine sediments. Southward-trending striae and the northward concavity of the deposit indicate that Baie des Chaleurs ice was the last to retreat from the area (Rampton et al., 1984).

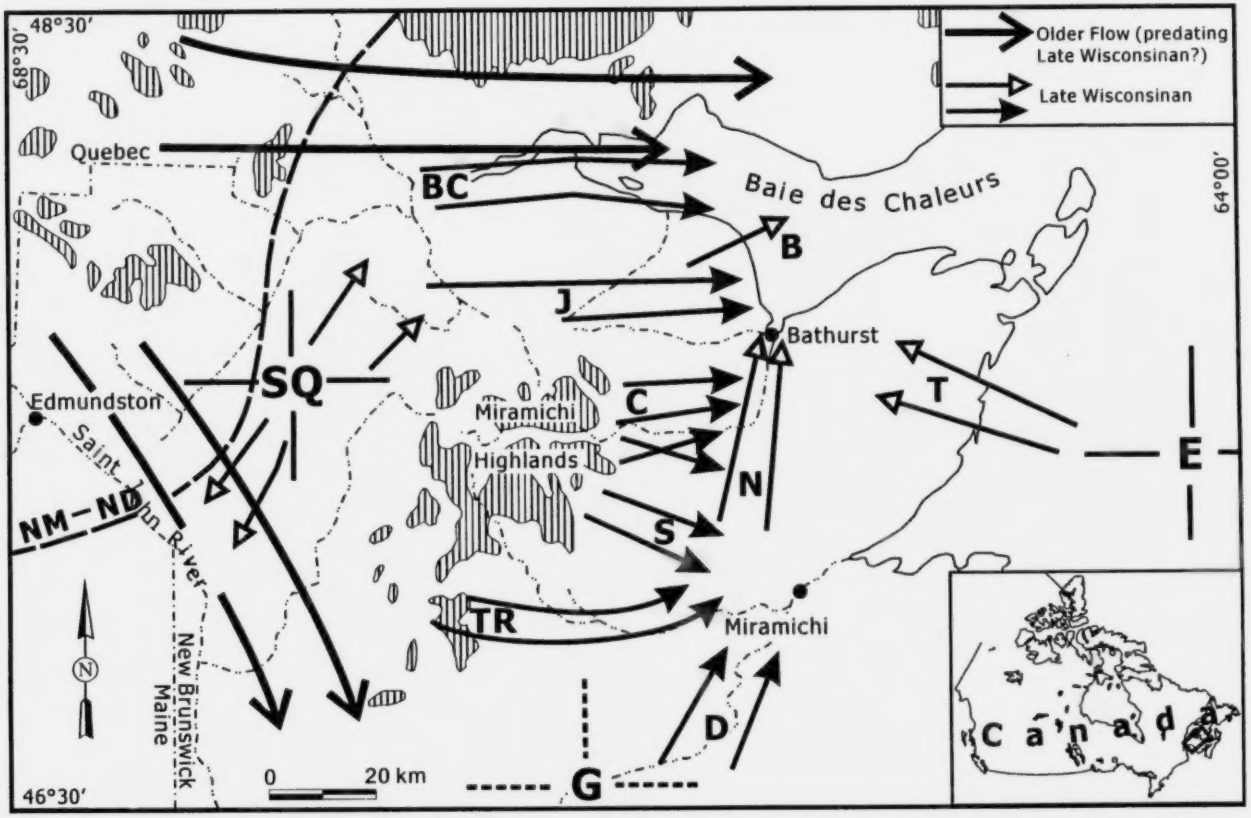



Figure 3.1: Location of former Appalachian ice centres (E-Escuminac; G-Gaspereau; SQ-St. Quentin) in northern New Brunswick and their associated ice-flow patterns(B-Belldune; BC-Baie des Chaleurs; C-California; D-Doaktown; J-Jacquet; N-Nepisguit; S-Sevogle; T-Tracadie; TR-Tuadook-Renous) and the North Maine-Notre Dame Ice Divide (NM-ND). Note: not all ice-flow directions are contemporaneous, see text for details (modified from Rampton et al., 1984; Pronk et al., 1989).

Numerous meltwater channels, eskers, morainal ridges, and cross-cutting striae indicate a complex deglaciation of the Nepisiguit lobe and ice from the Miramichi Highlands. DeGeer moraines indicate that ice was calving into water during its retreat (Rampton et al., 1984).

The latter part of the Bantalor phase is marked by the retreat of the North Maine Ice Divide and the decay of ice in the Eastern Miramichi Highlands (Rampton et al., 1984). The Gaspereau Ice Centre transformed to an ice divide composed of several small ice caps connected by sags and retreated westward. The latter part of the Bantalor phase is also characterized by rapid postglacial uplift, relative to sea-level rise (Rampton et al., 1984).

3.1.1.(iii) Millville/Dungarvon Phase

Ice flow patterns established during the Bantalor phase north of the Northern Miramichi Highlands were maintained during the Millville/Dungarvon phase (Rampton et al., 1984). Relative sea level at the mouth of the Jacquet River was approximately 32 m, indicating that present day coastal areas were still submerged during this phase (Rampton et al., 1984).

3.1.1.(iv) Plaster Rock and Chaleurs Phases

The Plaster Rock and Chaleur phases were concurrent phases affecting the northwestern part of the province and the northern and eastern areas adjacent to the Baie des Chaleurs, respectively (Rampton et al., 1984). These phases were characterized by the decay of the North Maine-Notre Dame Ice Complex into small ice caps in northwestern New Brunswick. Ice flowed out of the Notre Dame Mountains into the major river valleys and north-northwestward from the North Maine Ice Divide into the Edmundston Highlands (Figure 1.3); ice from the St-Quentin Ice Centre and the Notre Dame Mountains coalesced and flowed northeast to the Baie des Chaleurs (Rampton et al., 1984)(Figure 3.1).

Rampton et al. (1984) concluded that diamicton and glaciofluvial deposits overlying fossiliferous marine clays along the Baie des Chaleurs coast, near Charlo, indicate that the clays were overridden by glacier ice surging into the bay. The terminus was likely floating as the clays are, for the most part, undeformed, but are overlain by diamicton layers. Rampton et al. (1984) also

concluded that prior to this surge, ice may have retreated to the west of Campbellton, as shown by gravel beneath diamicton in that area. Lamothe (1992), however, interpreted the diamicton as debris flows, due to its lack of subglacial structures.

Rampton et al. (1984) concluded that the glacier surge responsible for the diamicton and glaciofluvial deposits diverted or dammed rivers flowing from the Chaleur Uplands (Figure 1.3) forming kames and kame deltas along the Chaleur Coastal plain (Figure 1.3). Rampton et al. (1984) also concluded that a suture was developed along the southern flank of the Baie des Chaleurs ice lobe (Figure 3.1), forming an interlobate moraine system consisting of ice-contact glaciofluvial sediments and ablation till, deposited subaqueously or as kame deltas. However, Bobrowsky et al. (1987) and Lamothe (1992) interpreted these sediments to be a series of nested, pitted deltas, suggesting an ice margin calving into the Baie des Chaleurs. The presence of kettles in the ridge near the mouth of the Charlo River (Figure 1.4) suggests that ice in that area may have been covered with thick deposits of glaciofluvial and glaciomarine sediments during the formation of the 'Restigouche Kame' (Rampton et al., 1984). As the ice margin receded up the bay, leaving the mouth of the Charlo River (Figure 1.4) ice-free, a delta began to develop, and ice-contact and morainal deposits were also formed in Balmoral (Figure 1.2) by ice from the north. Further retreat of the ice lobe led to the development of a glaciomarine delta in an interlobate position between the Baie des Chaleur lobe and ice from the Campbellton Hills (Rampton et al., 1984; Figures 1.3, 3.1).

Varved clays in the valley bottom of the Upsalquitch River indicate the formation of an ice-dammed glacial lake, Lake Upsalquitch, in its headwaters (Rampton et al., 1984). As the Jacquet Plateau (Figure 1.3) was deglaciated, Lake Upsalquitch expanded downstream and outlets to the Charlo River system were opened through Popelogan Lake and White Meadows Brook. At its fullest extent, Lake Upsalquitch drained across two drainage divides, into Black Brook (Rampton et al., 1984).

According to Rampton et al. (1984), small ice-caps in the Notre Dame Mountains and on the Saint Quentin Plateau (Figure 1.3), along with a small ice-mass at the junction of the Saint John and

Madawaska rivers, were the last remnants of glacier ice in New Brunswick. The end of the Plaster Rock phase (approximately 12 ka.) is coincident with the disintegration of these ice caps and marks the end of active glaciation in New Brunswick (Rampton et al., 1984).

### 3.1.2. Glacial Studies in the Baie des Chaleurs Region

Investigations of the surficial geology in the Baie des Chaleurs region began with Robert Chalmers in 1881. Since then, numerous studies have contributed to the understanding of the glacial history of the region (Chalmers, 1885, 1886, 1887, 1898; Gauthier, 1978, 1982, 1983; Brinsmead, 1979a, 1979b; Finamore, 1979a, 1979b; Rampton et al., 1984; Pronk, 1986, 1987; Lamothe, 1986, 1992; Bobrowsky et al., 1987; Pronk and Parkhill, 1988; Pronk et al., 1989).

Regional studies of the surficial geology and till geochemistry conducted by the New Brunswick Department of Natural Resources and Energy (Pronk, 1986, 1987; Pronk and Parkhill, 1988) and the Geological Survey of Canada (Lamothe, 1992) in the study area indicate a main ice-movement to the east followed by movement to the northeast. Pronk et al. (1989) conducted an analysis of ice-flow indicators derived from reports and field research conducted since 1985. They determined that the Baie des Chaleurs region experienced four major phases of ice flow during the Late Wisconsinan: 1) southeast, 2) east, 3) north-northeast, and 4) multidirectional (Pronk et al., 1989). The eastward flow is the most dominant trend in striae and clast provenance studies, whereas pebble fabrics measured in glacial sediments represent the later northeastward flow. Pronk et al. (1989) concluded that the regional shift in ice-flow from east to northeast resulted from a change in basal regime under the influence of drawdown in the Baie des Chaleurs, or that the northeast flow represented a separate event within the Late Wisconsinan advance.

Investigations of the granular aggregate resources in the study area were conducted by Brinsmead (1979a, 1979b). Erosional features (striae and grooves) in the Charlo (21 O/16) area indicate two ice-flow directions: northeastward at 050° and eastward at 080°. Some locations showed the 080° striae crosscutting the 050°, indicating a late-stage change in ice-flow direction,

or a minor retreat and readvance of the same ice lobe (Brinsmead, 1979a). Brinsmead (1979a) inferred that extensive deposits of ice-contact materials proximal to the coast of the Baie des Chaleurs indicated the existence of ice margins in the area.

Finamore (1979a) suggested that the east-northeastward striae found in the Atholville (21 0/15) map area likely represented the final advance of ice originating from the west. Esker or 'esker-like' sediments found in the Charlo river system suggest an east to northeastward flow of meltwater as ice receded to the west, leaving areas of active ice in the valley (Finamore, 1979a).

## 3.2 Geological Setting

### 3.2.1. Bedrock Geology

The study area is located in the Chaleur Zone of the Tobiquie-Chaleur Synclinorium tectonistratigaphic zone (Ruitenberg et al., 1977; Fyffe and Fricker, 1987). The study area is gently folded, with dips on the fold limbs of 2°- 15°. Fold hinges trend northeast-southwest and plunge gently to the southwest. Two prominent fault sets strike ENE and SE (J. P. Langton, pers. communication, November, 2000). The oldest rocks in the area are arc-related Middle to Late Ordovician mafic volcanic rocks and Caradocian slates and cherts of the Balmoral Group, an inlier of Dunnage Zone rocks exposed in the core of the Popelogan Anticline (Ruitenberg et al., 1977; Williams, 1979; van Staal and Fyffe, 1995; Wilson et al., 2000). The Balmoral Group is disconformably overlain by Late Ordovician to Early Silurian Matapedia Group rocks, consisting of sediments deposited as turbidites on a submarine slope. The Matapedia Group is conformably overlain by Silurian sedimentary and volcanic rocks of the Chaleurs Group (Ruitenberg et al., 1977; Williams, 1979; van Staal and Fyffe, 1995; Wilson et al., 2000).

Bedrock exposures in the study area are rare. The best exposures are along river valleys and bedrock ridges. Argillaceous and calcareous sandstones and siltstones of the Chaleurs Group and limestones interlaminated with calcareous shales of the Matapedia Group underlie most of the western part of the study area; mafic volcanic rocks, minor tuff, chert and graptolitic slate of the Balmoral Group are also present (Figure 3.1; Wilson, 2000a, 2000b).

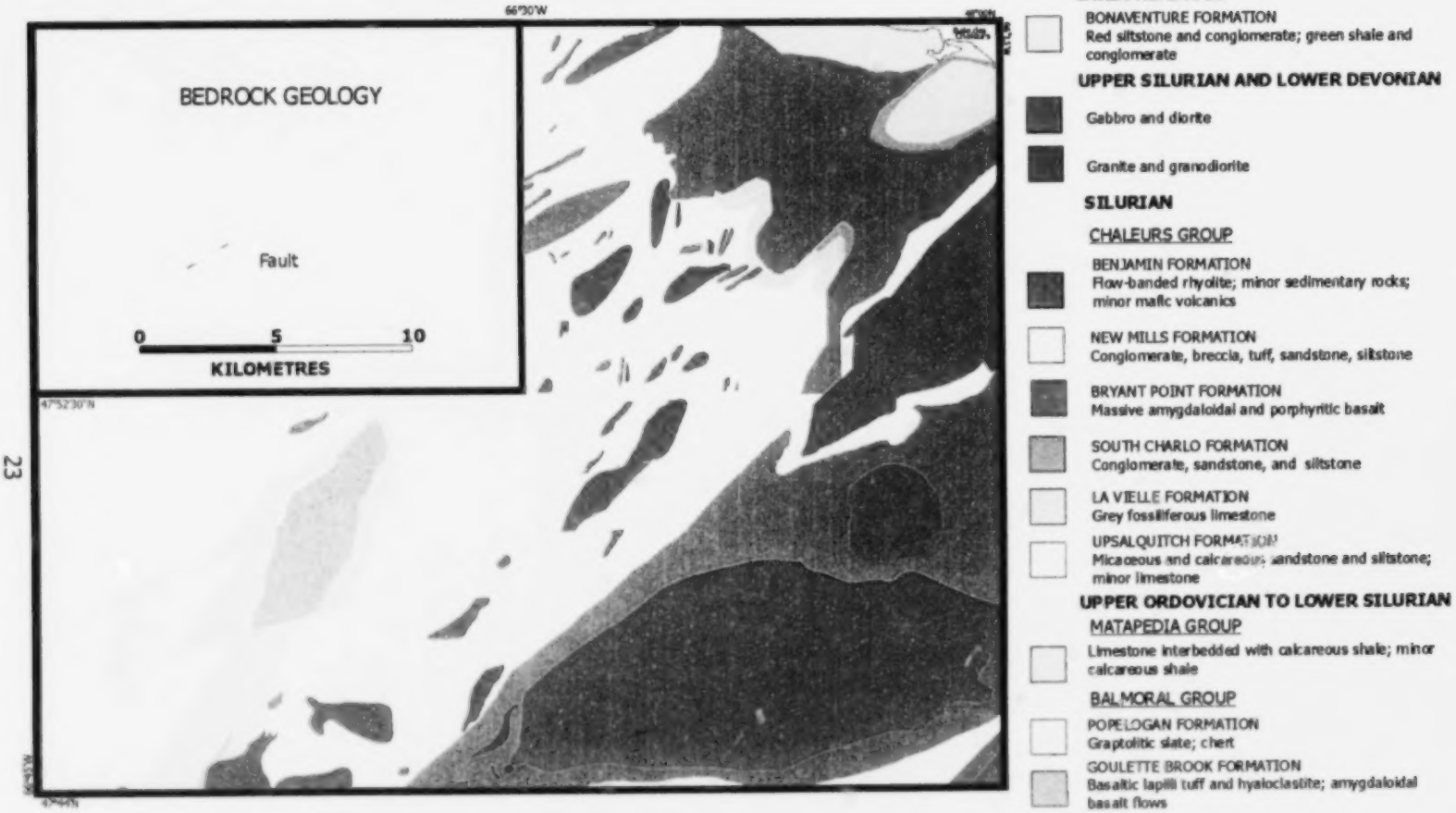



Figure 3.2: Geological map of the study area (modified from Wilson, 2000a, 2000b; Langton, 1999, 2000)

The majority of the eastern part of the study area is underlain by Chaleurs Group volcanic rocks. Massive amygdaloidal and porphyritic basalts are exposed in the northeastern and central regions of the study area. Felsic volcanic rocks and associated sedimentary rocks are also found in the northeast, as well as to the south. In the north, along the Baie des Chaleurs, Carboniferous sandstone, shale, and conglomerate of the Bonaventure Formation are exposed. The central region is underlain mainly by fossiliferous limestone and volcanic boulder conglomerate, breccia, and tuff.

According to Irrinki (1990), Devonian granite, granodiorite, and monzonite stocks are common throughout the study area (Figure 3.1). Dykes and sills associated with the stocks comprise dioritic feldspar porphyry, granite porphyry, gabbro, and aplite (Quatermain, 1981; Woods, 1993).

### 3.2.2. Mineral Occurrences

Mineral exploration began in the study area in the 1950s and remains ongoing to date. Anomalous stream sediment and soil geochemistry values from these investigations led to the discovery of base metal, Cu, Pb, Zn, occurrences, none of which are presently of economic interest. Currently, there are eleven known mineral occurrences (denoted by a Unique Referencing Number - URN) in the study area (Figure 3.2) that may be used as point sources for glacial dispersal studies.

#### Benjamin River Complex

The Benjamin River Complex comprises four deposits of porphyry-type Cu-Mo mineralization: South A (URN #0055), South B (URN #1078), South C (URN # 0894), and South D (URN # 1111). The mineralization is stockwork-type with fine disseminations (chalcopyrite and molybdenite), mineralized narrow fractures, and quartz veinlets, and is related to a Devonian granodiorite intrusive complex intruding Silurian, Bryant Point Formation volcanic rocks (Figures 3.2, 3.3; Rose and Johnson, 1990).

#### Popelogan Group

Sulphide mineralization (Cu, Mo, Pb, and Zn) is found in the Popelogan Lake (URN #0088), Popelogan North (URN #0089), South (URN #1102), and East (URN #1101) Zones. The Popelogan

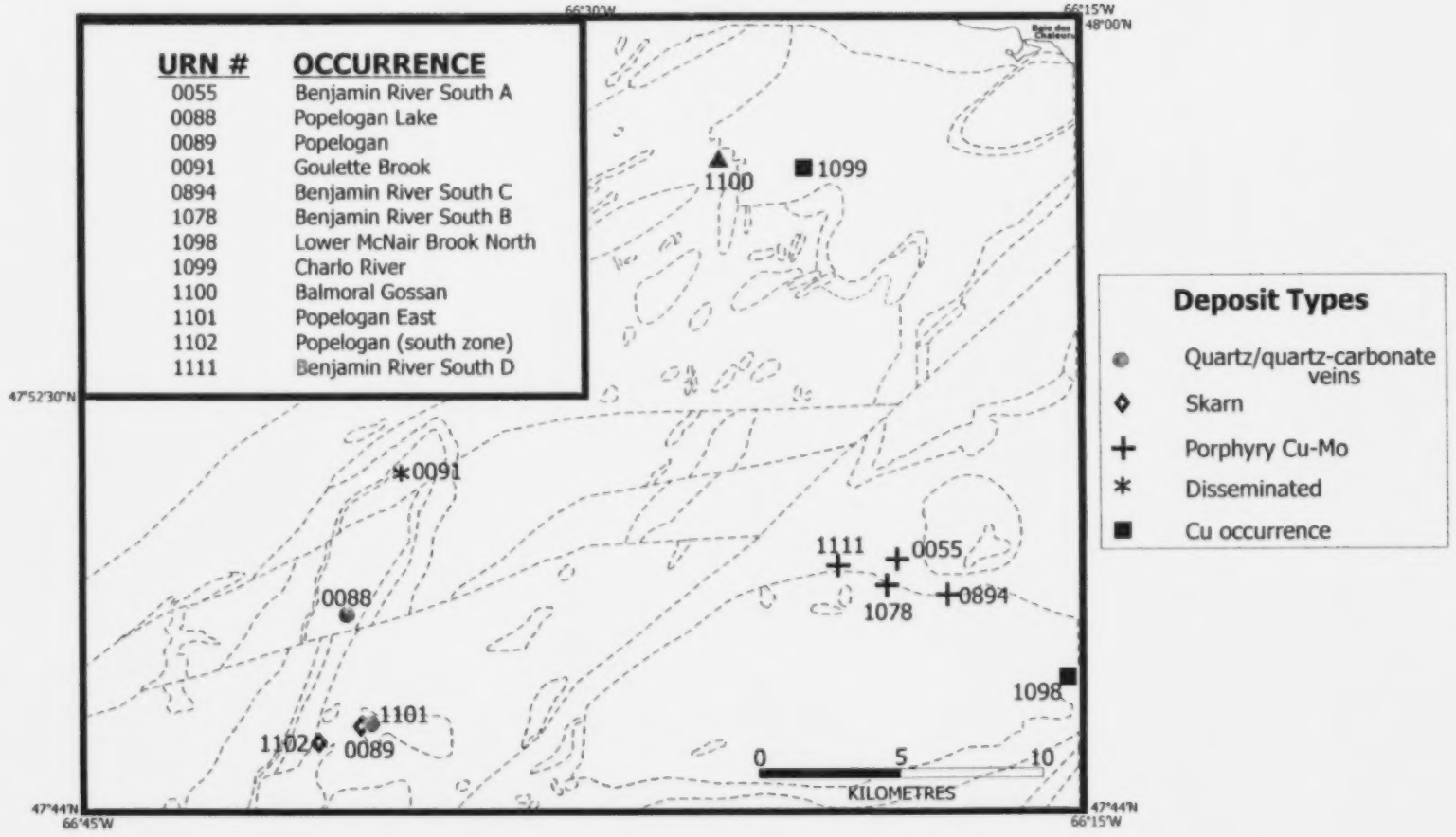



FIGURE 3.3: Known mineral occurrences in the study area. Bedrock units are outlined by dashed lines, see Figure 3.2 for details.

occurrence is the largest mineral occurrence in the study area, containing 3.1 million tonnes @ 0.3% Cu (Quartermain, 1981). The Popelogan North and South Zones are hosted by a skarn formed around apophyses of the Popelogan granodiorite stock and related dykes and sills intruding Silurian limestone. Sulphide mineralization (Cu, Mo, Zn, Pb, W, and As) occurs as disseminations, isolated pockets of massive material, and in quartz-chlorite-carbonate veinlets. The Popelogan East Zone is hosted by a quartz vein system cutting the Popelogan intrusion and its surrounding hornfels. It is characterized as a greisen and stockwork vein deposit with mineralization occurring as selvages along quartz veins and as vein fillings. The Popelogan Lake occurrence is hosted by quartz-carbonate veins and stockworks associated with fracture/shear zones. The mineralization occurs as disseminations and stringers (Rose and Johnson, 1990).

Goulette Brook (URN #0091)

The Goulette Brook Cu, Pb, Zn, Ag deposit occurs as irregular veinlets, disseminations, and small isolated pods in highly altered palagonite tuff of the Goulette Brook Formation (Rose and Johnson, 1990).

Lower McNair Brook North (URN #1098) and Charlo River (URN #1099)

These deposits are denoted as copper occurrences; however, not enough information is presently available to classify them further.

# CHAPTER 4

# RESULTS AND INTERPRETATIONS

## 4.1 Surficial Sediments and Landforms

Due to the complex glacial history and physiographic setting, the study area has a variety of glacial sediments and landforms. The genetic categories of sedimentary units include: tills, humus, glaciofluvial, ice-contact, glaciomarine, post-glacial fluvial, and colluvium.

### 4.1.1 Till

Basal till (sensu stricto, Dreimanis, 1976) blankets the majority of the study area. Only one stratigraphic till unit was observed; however, the colour and texture vary from site to site, reflecting the characteristics of the underlying bedrock. The colour of the till unit varies from olive brown to yellowish brown over most of the area, but exhibits a reddish-brown hue over reddish-brown coloured rocks of the Benjamin, New Mills, and Bonaventure formations (Figure 3.2). The texture also changes in response to underlying bedrock and varies from sandy loam over igneous bedrock to silty clay loam over sedimentary bedrock. Where exposed, till thickness is seen to vary from a thin veneer (< 0.5 m) at elevations above 450 m, to till blankets (> 2 m) at elevations below 400 m. Till veneer overlying bedrock is common in the southeast, particularly over Blue Mountain (Figure 1.2), while till thicknesses are greater than 4m in low lying areas in the western part of the study area. Compactness of the unit varies from moderate to extremely dense.

Basal till is found in the form of three different end-members: melt-out, lodgement, and deformation tills (Dreimanis, 1976). These tills, deposited penecontemporaneously, form a continuum as melt-out till grades downward into lodgement and/or deformation till. At some sites deformation till occurs at the surface as a thin veneer overlying bedrock.

Minor deposits of ablation lag are found overlying basal till. Typically, this material is a

veneer of coarse, striated fragments of local bedrock with the finer grain-size material winnowed away. This material, interpreted as ablation till, is commonly coarser and less compact than basal till, but typically exhibits a similar colour.

Soil profiles in the study area are generally podzolic (sensu stricto, Agriculture Canada, 1987) in nature (Figure 4.1). The Ae horizon, a zone of leaching of clay, Fe and Al, is typically 1 to 16 cm thick, with a sandy texture. The Bf, or illuvial, horizon commonly has a reddish hue due to the accumulation of Fe. The BC horizon, a transitional horizon between the Bf and C horizons, becomes more yellow to olive coloured from the red colour of the Bf, as it grades into the C horizon (the weathered portion of the till).

### 4.1.2 Humus

Humus is the decomposed organic matter that is well-mixed with the mineral material of the upper horizons of the soil (Fitzpatrick, 1986). Humification, the process of humus formation, began shortly after deglaciation and is ongoing today . Humus thickness is typically 1 to 10 cm throughout the study area, except in poorly drained areas where thicknesses are greater than 1 m.

### 4.1.3 Glaciofluvial

Extensive deposits of glaciofluvial sediments are found parallelling the Baie des Chaleurs coast, along the northeast corner of the study area (Figure 1.2). These deposits consist of stratified sands/silts and coarse gravels, inclined basinward. Changes in grain-size and degree of sorting, as well as the thickness of each deposit vary considerably where examined in profile (Figure 4.2). These stratified units overlie till and most likely represent glaciofluvial deltaic sediments formed as part of a retreat sequence (cf. Broster and Clague, 1987). Evidence of faulting and slumping of the glaciofluvial unit were observed at some sites, likely indicating deposition in an ice marginal environment (cf. Broster and Clague, 1987). Minor amounts of glaciofluvial material were observed in larger river valleys in the northeast. These sediments range from coarse gravels to sand, with grain size decreasing in a downstream direction.

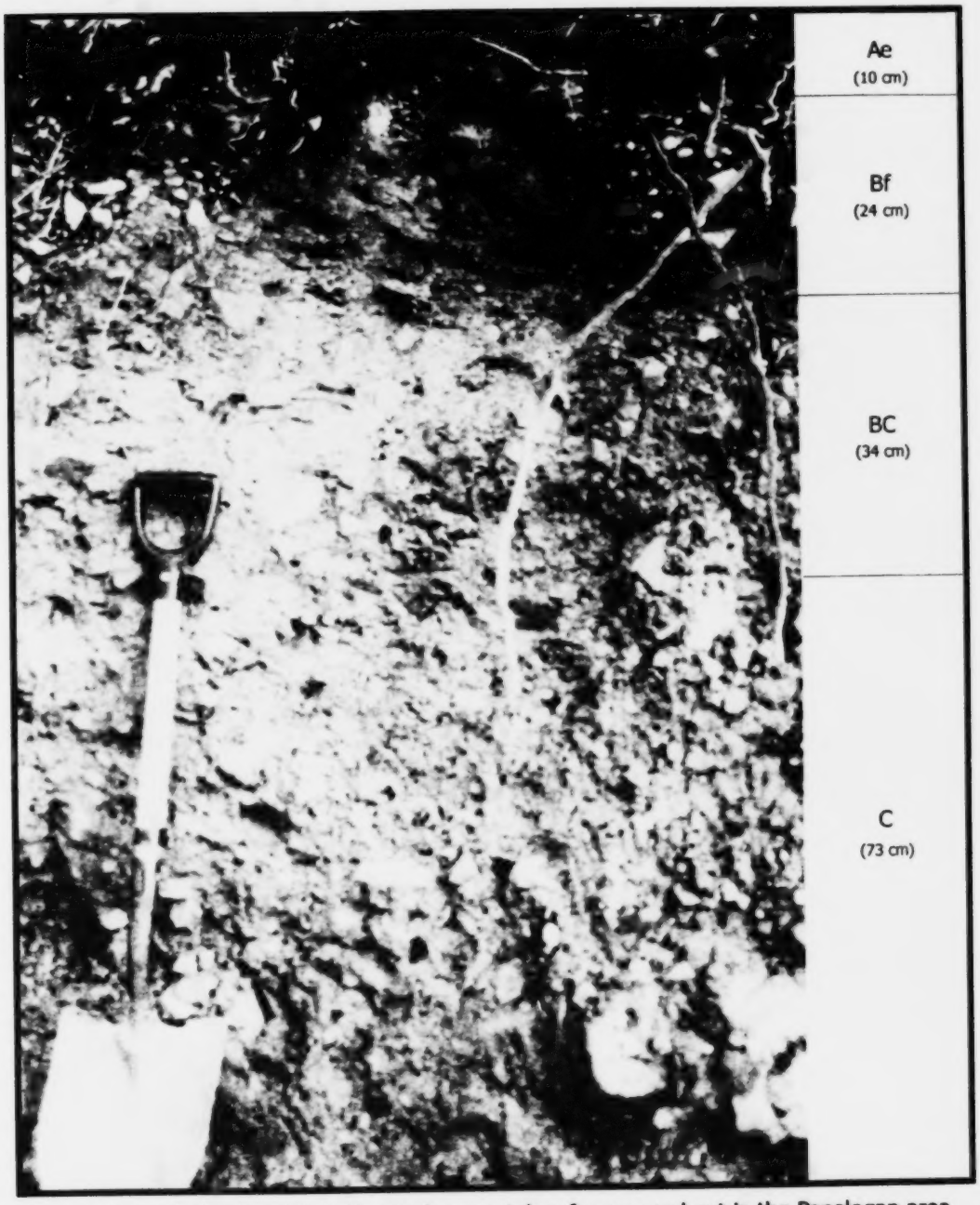



Figure 4.1: Typical soil profile in the study area, taken from a road-cut in the Popelogan area (21 O/15E). Soil profile is developed on yellow-olive coloured silty-loam basal till with clasts of Matapedia Group limestone.

Figure 4.2: Ice-contact deltaic sediments consisting of stratified sands/silts and coarse gravels, inclined northeastward towards the Baie des Chaleurs. Grain-size, degree of sorting and thickness of each units varies throughout the 13 ft. section. Faulting and slump features indicated an ice marginal environment of deposition. Section is exposed in a gravel pit located in the township of Charlo (21 O/16E).

### 4.1.4 Glaciomarine

Glaciomarine clays are exposed in cut banks near the mouth of the Charlo River (Figures 1.4, 4.3). The silty clay unit is rhythmically layered and varies in thickness along the exposure. The layers vary in colour from grey at the bottom of the exposure to reddish-brown at the top, where they have been oxidized. Stratigraphically, these glaciomarine clays lie above a red diamicton unit, likely a till, and below a unit of glaciofluvial sands and gravels.

### 4.1.5 Post-glacial Fluvial

Fluvial deposits consist of sorted and stratified sands, silts, and well-rounded gravels deposited by post-glacial streams. Significant deposits of these sediments occur as valley fills in the major river valleys (Figures 1.4, 1.5) and, most noticeably, as terraces and floodplains at the mouths of the rivers.

### 4.1.6 Colluvium

Weathered bedrock and glacial deposits have been reworked by sheet erosion and mass wasting to produce colluvial deposits. Colluvium is recognized as a thin layer, thickening downslope, of broken and weathered bedrock clasts in a poorly sorted, sandy matrix. Colluvium occurs in the study area as a veneer over exposed bedrock and as colluvial blankets along and at the base of slopes.

### 4.1.7 Erosional landforms (ice-flow indicators)

Thick overburden, vegetation cover, and deep weathering limited the number of exposed, well-preserved, striated outcrops in the study area. A total of 40 striae measurements were recorded (Table 4.1), the majority of which were limited to the eastern part of the study area (Figure 4.4), which is underlain by more resistant igneous bedrock.

Measurements of striae orientation (Table 4.1) indicate ice movements in three general directions: northeast, east, and southeast, with the most dominant trend towards the northeast (Tables 4.1, 4.2). Only one outcrop, located approximately 10 km to the east of the study area in

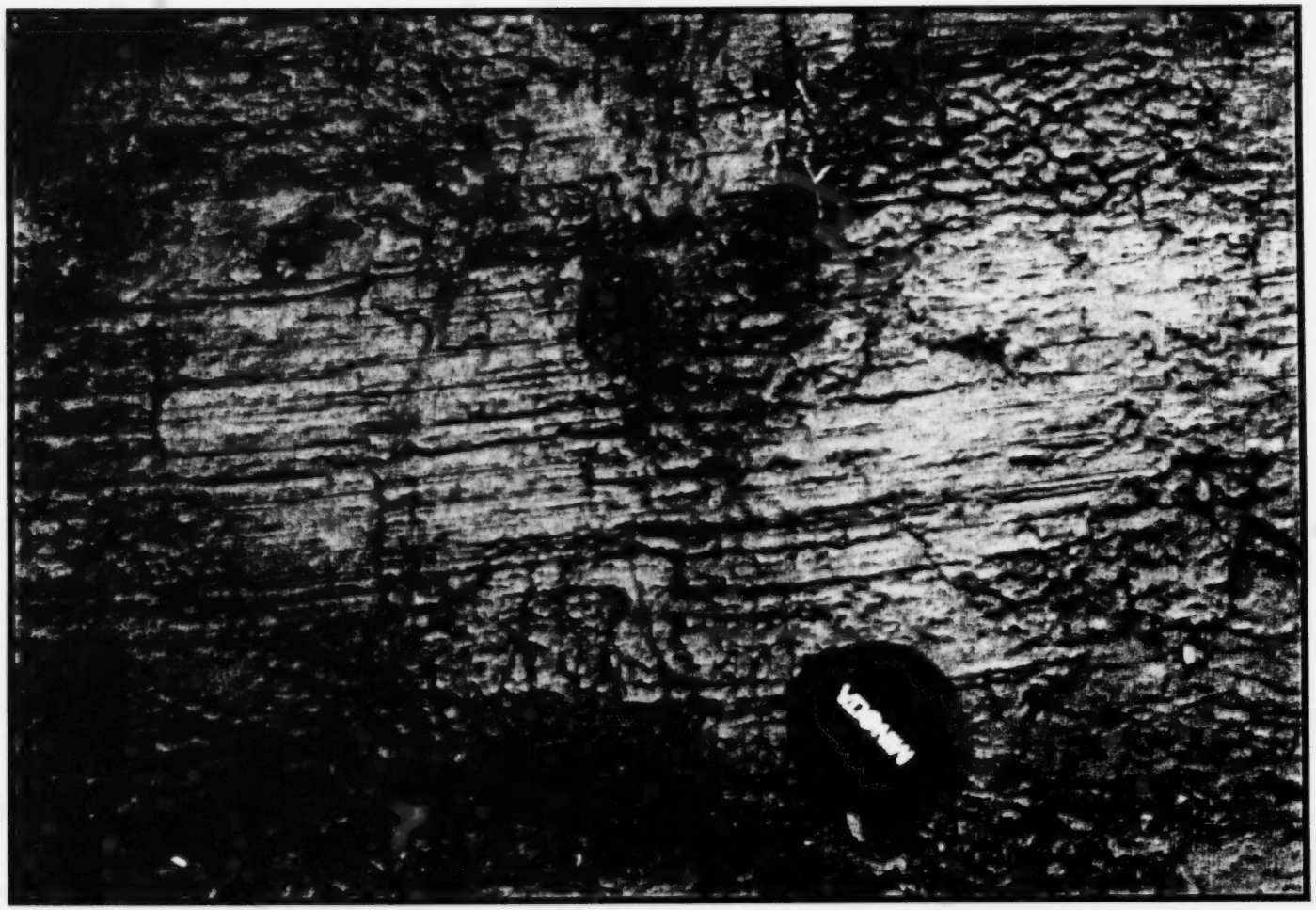


Figure 4.3: Rhythmically layered glaciomarine silty clay exposed in a cutbank near the mouth of the Charlo River.

**Table 4.1: Striae measurements**

| Site Number | Map Sheet | Azimuth (degrees) | Features |
|---|---|---|---|
| S99-01 | O/16 | 45 | st |
| S99-02 | O/16 | 85 | st+gr |
| S99-03 | O/15 | 51 | st+gr |
| S99-04 | O/15 | 50 | st+gr |
| S99-05 | O/15 | 60 | st |
| S99-06 | O/16 | 40 | st |
| S99-07 | O/16 | 48 | st |
| S99-08 | O/16 | 45 | st+gr |
| S99-09 | O/16 | 94 | rt |
| S99-10 | O/16 | 40 | st+gr |
| S99-11 | O/16 | 58 | st+gr+rt |
| S99-12 | O/16 | 38 | st+g |
| S99-13 | O/16 | 38 | st+gr |
| S99-14 | O/16 | 38 | st |
| S99-15 | O/16 | 30 | st |
| S99-16 | O/16 | 24 | st |
| S99-17 | O/16 | 44 | st |
| S99-18 | O/16 | 44 | st |
| S99-19 | O/16 | 72 | st+gr |
| S99-20 | O/16 | 102 | st+gr |
| S99-21 | O/16 | 40 | st+gr |
| S99-22 | O/16 | 46 | gr |
| S99-23 | O/16 | 59 | st+gr |
| S99-24 | O/16 | 38 | st+gr |
| S99-25 | O/16 | 74 | st |
| S99-26 | O/16 | 104 | st |
| S99-27 | O/16 | 74 | st |
| S99-28 | O/16 | 24 | st+gr |
| S99-29 | O/16 | 26 | st+gr |
| S99-30 | O/16 | 96 | st+gr |
| S99-31 | O/16 | 30 | st |
| S99-32 | O/16 | 136 | st |
| S99-33 | O/16 | 20 | st+gr+rm |
| S99-34 | O/16 | 80 | st+gr |
| S99-35 | O/16 | 76 | st+gr+rm |
| S99-36 | O/16 | 75 | st+gr+rm |
| S99-37 | O/16 | 168 | st+gr+rt |
| S99-38* | O/16 | 10 | str+facets |
| S99-39* | O/16 | 110 | str |
| S99-40* | O/16 | 160 | str |

| Notes |
|---|
| striae measured outside of study area |
| denoted by * |
| - st = striae |
| gr = groove |
| rt = rattail |
| rm = roche moutonee |
| striae direction known |

**Table 4.2: Frequency of striae measurements categorized by azimuth**

| | Range | Frequenc | Cumulati |
|---|---|---|---|
| NE | 0 - 9 | 0 | 0% |
| | 10 - 19 | 1 | 3% |
| | 20 - 29 | 4 | 13% |
| | 30 - 39 | 6 | 28% |
| | 40 - 49 | 9 | 50% |
| | 50 - 59 | 4 | 60% |
| | 60 - 69 | 1 | 63% |
| E | 70 -79 | 5 | 75% |
| | 80 - 89 | 2 | 80% |
| | 90 - 99 | 2 | 85% |
| | 100 - 109 | 2 | 90% |
| SE | 110 - 119 | 1 | 93% |
| | 120 - 129 | 0 | 93% |
| | 130 - 139 | 1 | 95% |
| | 140 - 149 | 0 | 95% |
| | 150 - 159 | 0 | 95% |
| | 160 - 169 | 2 | 100% |

**Table 4.1: Striae measurements**

| Site Number | Map Sheet | Azimuth (degrees) | Features |
|---|---|---|---|
| S99-01 | O/16 | 45 | st |
| S99-02 | O/16 | 85 | st+gr |
| S99-03 | O/15 | 51 | st+gr |
| S99-04 | O/15 | 50 | st+gr |
| S99-05 | O/15 | 60 | st |
| S99-06 | O/16 | 40 | st |
| S99-07 | O/16 | 48 | st |
| S99-08 | O/16 | 45 | st+gr |
| S99-09 | O/16 | 94 | rt |
| S99-10 | O/16 | 40 | st+gr |
| S99-11 | O/16 | 58 | st+gr+rt |
| S99-12 | O/16 | 38 | st+g |
| S99-13 | O/16 | 38 | st+gr |
| S99-14 | O/16 | 38 | st |
| S99-15 | O/16 | 30 | st |
| S99-16 | O/16 | 24 | st |
| S99-17 | O/16 | 44 | st |
| S99-18 | O/16 | 44 | st |
| S99-19 | O/16 | 72 | st+gr |
| S99-20 | O/16 | 102 | st+gr |
| S99-21 | O/16 | 40 | st+gr |
| S99-22 | O/16 | 46 | gr |
| S99-23 | O/16 | 59 | st+gr |
| S99-24 | O/16 | 38 | st+gr |
| S99-25 | O/16 | 74 | st |
| S99-26 | O/16 | 104 | st |
| S99-27 | O/16 | 74 | st |
| S99-28 | O/16 | 24 | st+gr |
| S99-29 | O/16 | 26 | st+gr |
| S99-30 | O/16 | 96 | st+gr |
| S99-31 | O/16 | 30 | st |
| S99-32 | O/16 | 136 | st |
| S99-33 | O/16 | 20 | st+gr+rm |
| S99-34 | O/16 | 80 | st+gr |
| S99-35 | O/16 | 76 | st+gr+rm |
| S99-36 | O/16 | 75 | st+gr+rm |
| S99-37 | O/16 | 168 | st+gr+rt |
| S99-38* | O/16 | 10 | str+facets |
| S99-39* | O/16 | 110 | str |
| S99-40* | O/16 | 160 | str |

| Notes |
|---|
| striae measured outside of study area |
| denoted by * |
| - st = striae |
| gr = groove |
| rt = rattail |
| rm = roche moutonee |
| striae direction known |

**Table 4.2: Frequency of striae measurements categorized by azimuth**

| | Range | Frequenc | Cumulati |
|---|---|---|---|
| NE | 0 - 9 | 0 | 0% |
| | 10 - 19 | 1 | 3% |
| | 20 - 29 | 4 | 13% |
| | 30 - 39 | 6 | 28% |
| | 40 - 49 | 9 | 50% |
| | 50 - 59 | 4 | 60% |
| | 60 - 69 | 1 | 63% |
| E | 70 -79 | 5 | 75% |
| | 80 - 89 | 2 | 80% |
| | 90 - 99 | 2 | 85% |
| | 100 - 109 | 2 | 90% |
| SE | 110 - 119 | 1 | 93% |
| | 120 - 129 | 0 | 93% |
| | 130 - 139 | 1 | 95% |
| | 140 - 149 | 0 | 95% |
| | 150 - 159 | 0 | 95% |
| | 160 - 169 | 2 | 100% |

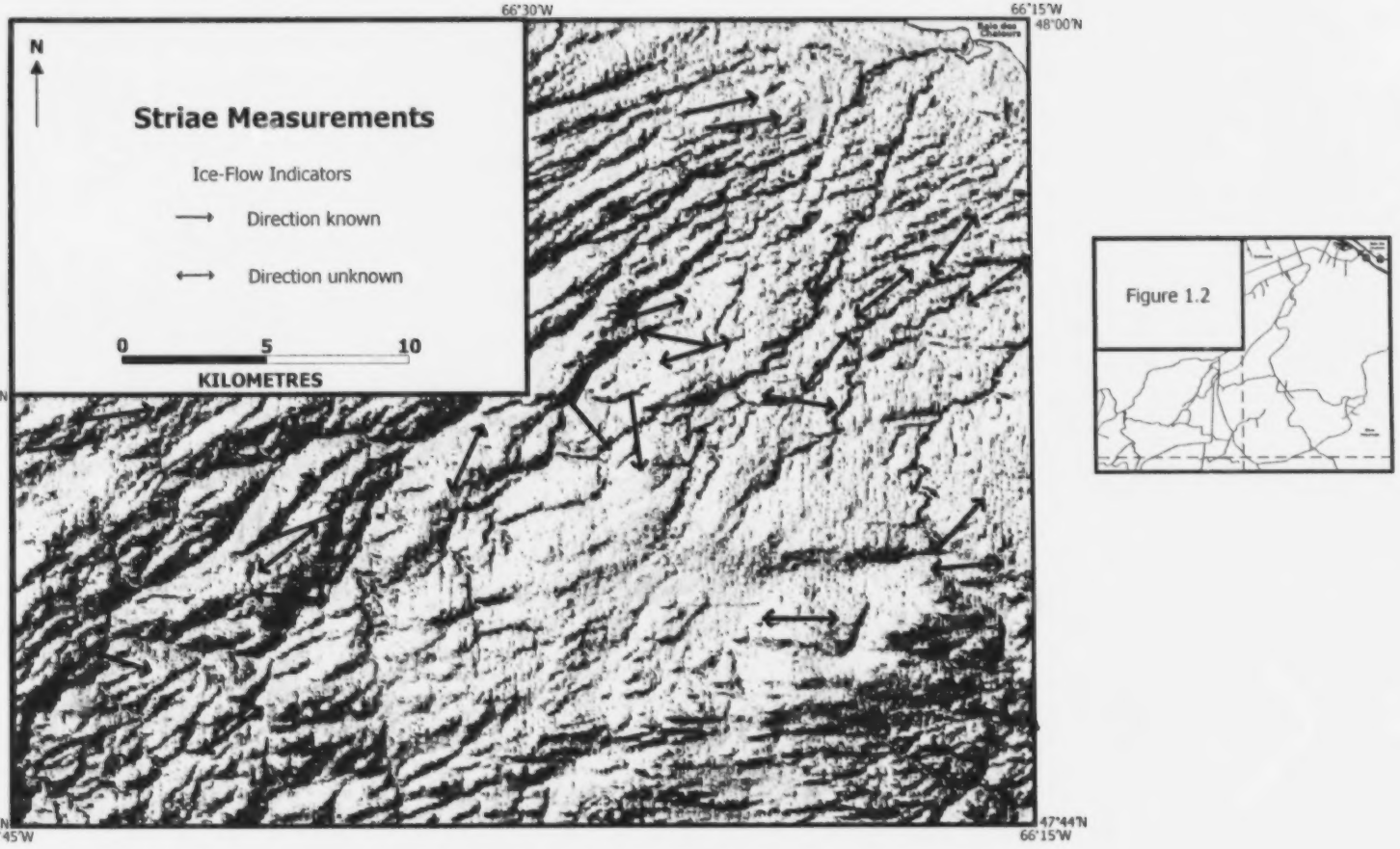



Figure 4.4: Ice-flow indicators measured in the study area.

the township of Lorne (Figure 1.2), recorded a cross-cutting relationship with all three ice movements (Figure 4.5). This cross-cutting relationship indicates relative ages of the ice movements, from oldest to youngest, of: 1) 160°, 2) 110°, and 3) 010°.

## 4.2 Lithological Analysis and Interpretations

Till clasts were collected at 171 sites in the study area (Figure 2.1; Appendix III), 110 of which were located in the vicinity of the Popelogan porphyryr-skarn occurrences (Figures 2.2, 3.3). Clast dispersal was delineated by counting the relative abundances (as percentages of the total amount of clasts collected at each site) of the following representative lithological groups: granite/granodiorite (porphyry), skarn (metamorphosed/metasomatized calcareous sedimentary rocks), hornfels, sedimentary rocks (limestone, siltstone, sandstone, conglomerate, and chert), and quartz. The concentrations form patterns likely representing dispersal from source units.

### 4.2.1 Granitoid Clasts

Granitoid clasts occur in concentrations up to 100% of till clast content in the study area. An elongate glacial dispersal pattern (25 -75%) extends 7 km north from a granitic intrusion near Blue Mountain (Figure 1.2) in the southeast corner of the study area (Figure 4.6). Several other dispersal patterns appear to be point sources associated with smaller intrusions in the area (see Figure 3.2).

Dispersal patterns in the area of the Popelogan porphyry-skarn occurrences (Figure 3.3) are irregular in shape (Figure 4.6). High clast concentrations (100%) are found directly over and to the northeast of the intrusive body associated with the Popelogan South occurrence, forming a bulls-eye dispersal pattern. A small, irregular dispersal pattern, oriented east-northeast is associated with the Popelogan intrusion.

### 4.2.2 Skarn and Hornfels Clasts

A dispersal pattern of skarn clasts occurs around the Popelogan occurrence with concentrations ranging from 0 to 22% (Figure 4.7). The highest concentration of clasts (22%)

**Figure 4.5**: Striated outcrop located 13 km east of study area. Cross-cutting striae indicate three major ice-flow events: (1) (marker) 160°, (2)(pen) 110°, (3)(pencil) 010°.

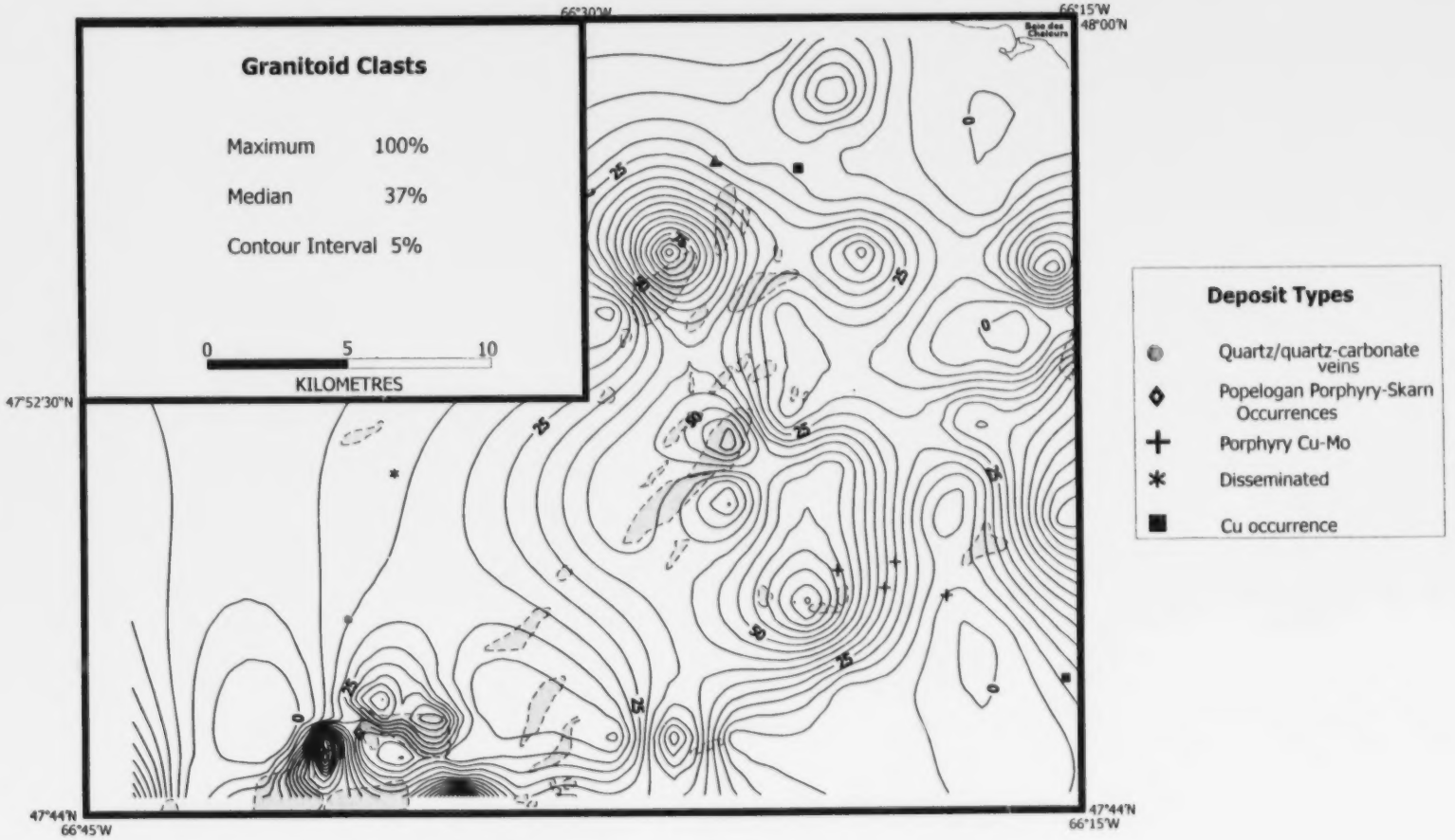



Figure 4.6: Dispersal patterns of granitoid clasts in the till matrix. Shaded areas indicate possible source bedrock units (from Figure 3.2).

occurs directly northeast of the Popelogan occurrences. The dispersal pattern extends north-northwest; however, no samples were collected to the northwest of the occurrences, thus the dispersal pattern is most likely a result of computer software interpolation.

Concentrations of hornfels clasts range from 0 to 11% throughout the study area. Dispersal patterns in the Popelogan area (Figure 4.8) have a similar north-northwest orientation to the skarn clast dispersal (Figure 4.7) and again, the elongation is likely a result of software interpolation. A second dispersal pattern of hornfels clasts extends 6 km to the southeast from a point in the northeast corner of the study area. This pattern is possibly related to small mafic and felsic intrusions. A bulls-eye pattern (8%) with slight elongation to the southeast occurs approximately 3 km southwest of a large mafic intrusion in the southeast corner of the study area. Another pattern with concentrations of 6% occurs on the eastern edge of the study area, just east of a large mafic intrusion.

### 4.2.3 Mineralized Clasts

Small concentrations (<11%) of mineralized (pyrite, pyrrhottie, chalcopyrite, molybdenite) clasts form dispersal patterns (Figure 4.9) in the vicinity of the Popelogan porphyryr-skarn occurrences. A small dispersal pattern (3 km) extends eastward from the Popelogan East occurrence. A bulls-eye anomaly (11%) is located northeast of the Popelogan South (or southeast of the Popelogan occurrence).

### 4.2.4 Basalt Clasts

Basalt clast concentrations range from 0 to 60%. Basalt dispersal patterns (Figure 4.10) are prominent in the eastern section of the study area, with a small (< 2 km), northward-oriented pattern occurring in the southwest corner of the study area. All dispersal patterns in the east occur in areas overlying basalts flows of the Bryant Point Formation (Figure 3.2). On the southern edge of the study area, dispersal patterns with concentrations greater than 50% extend north-northeastward for 5 to 6 km. Two adjoining bulls-eye patterns (>50%) occur in the northeast

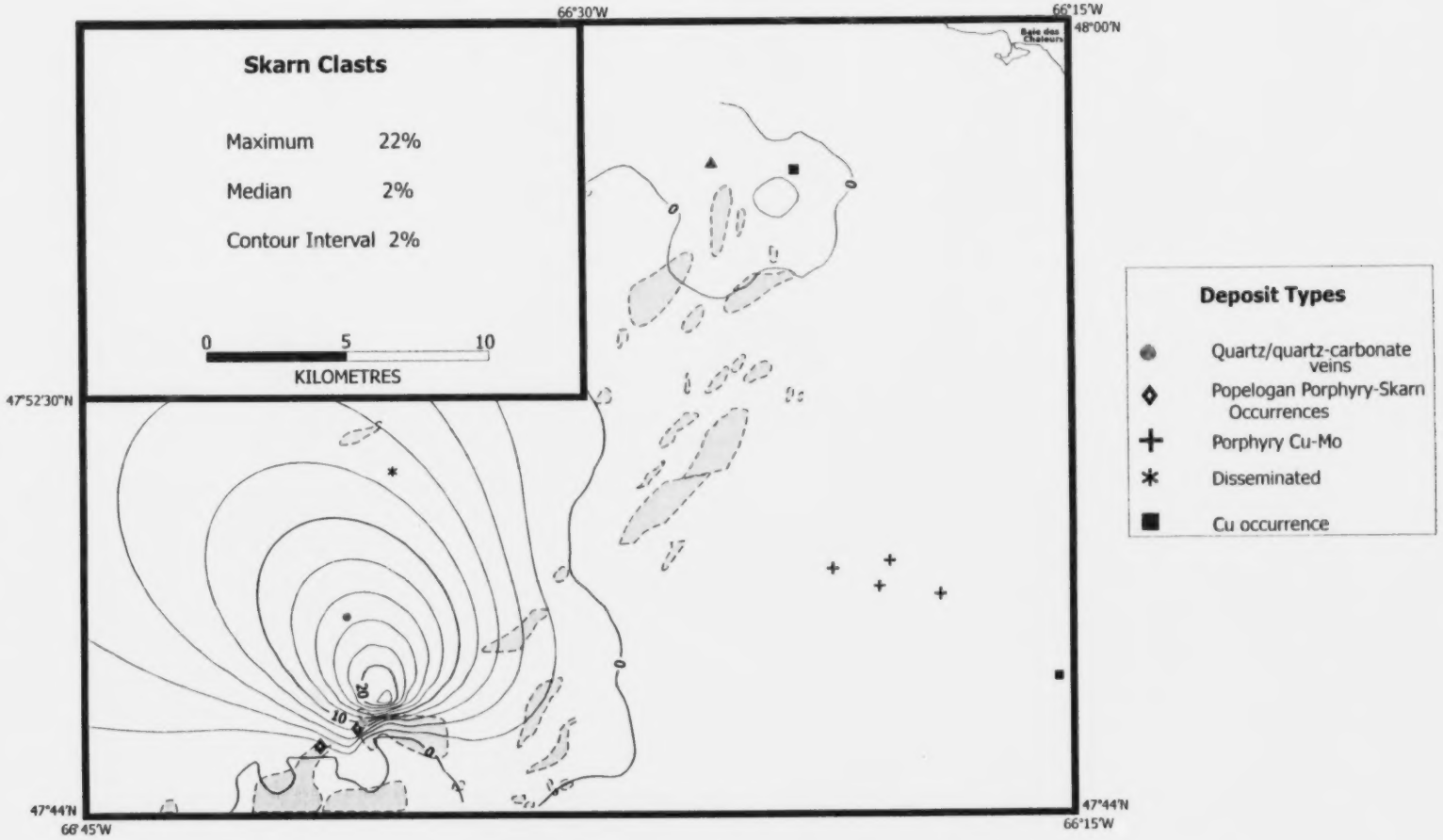



Figure 4.7: Dispersal patterns of skarn clasts in the till matrix. Shaded areas indicate possible source bedrock units (from Figure 3.2).

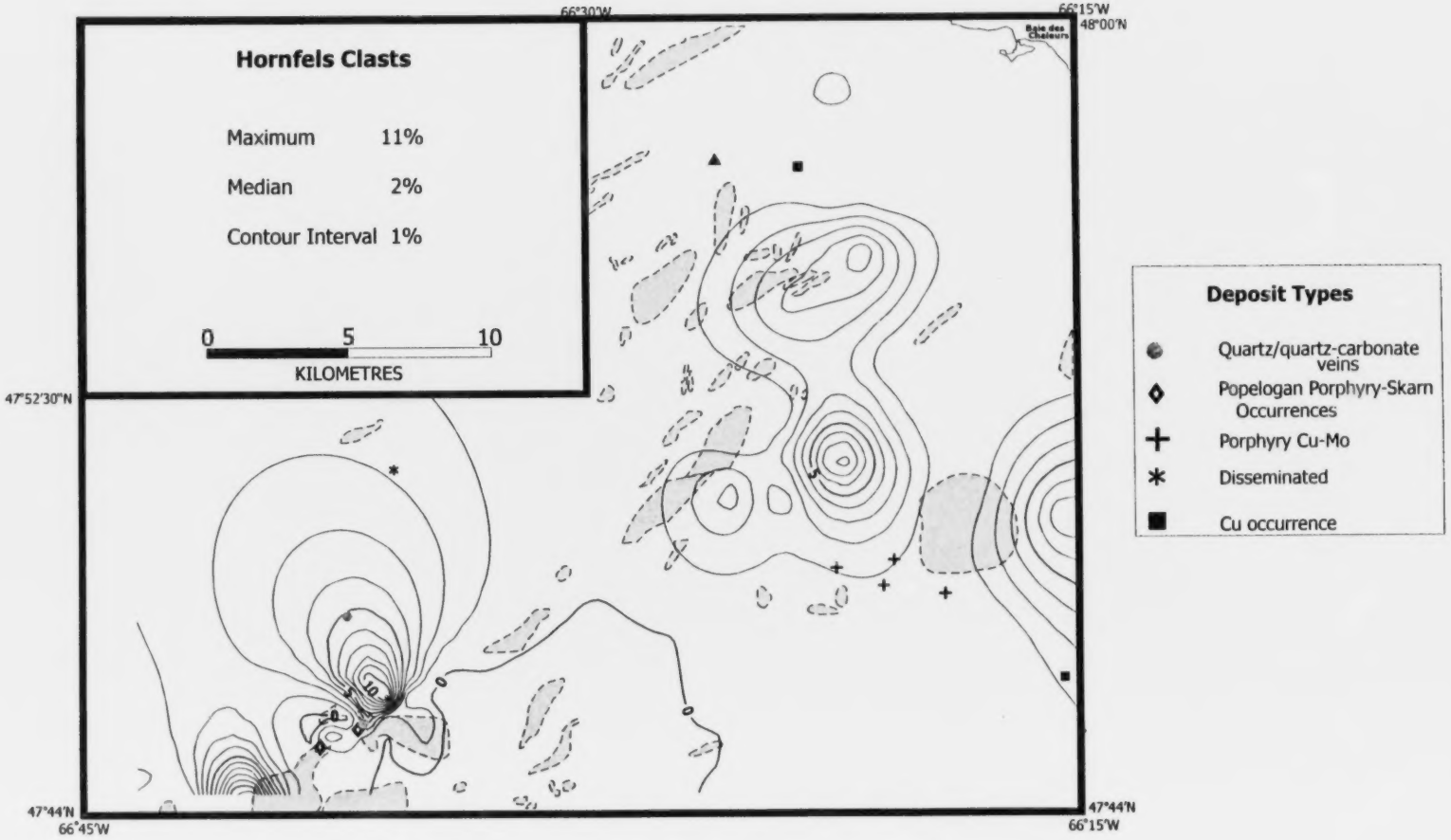



Figure 4.8: Dispersal patterns of hornfels clasts. Shaded areas indicate Devonian intrusions related to the hornfelsed sedimentary units (from Figure 3.2)

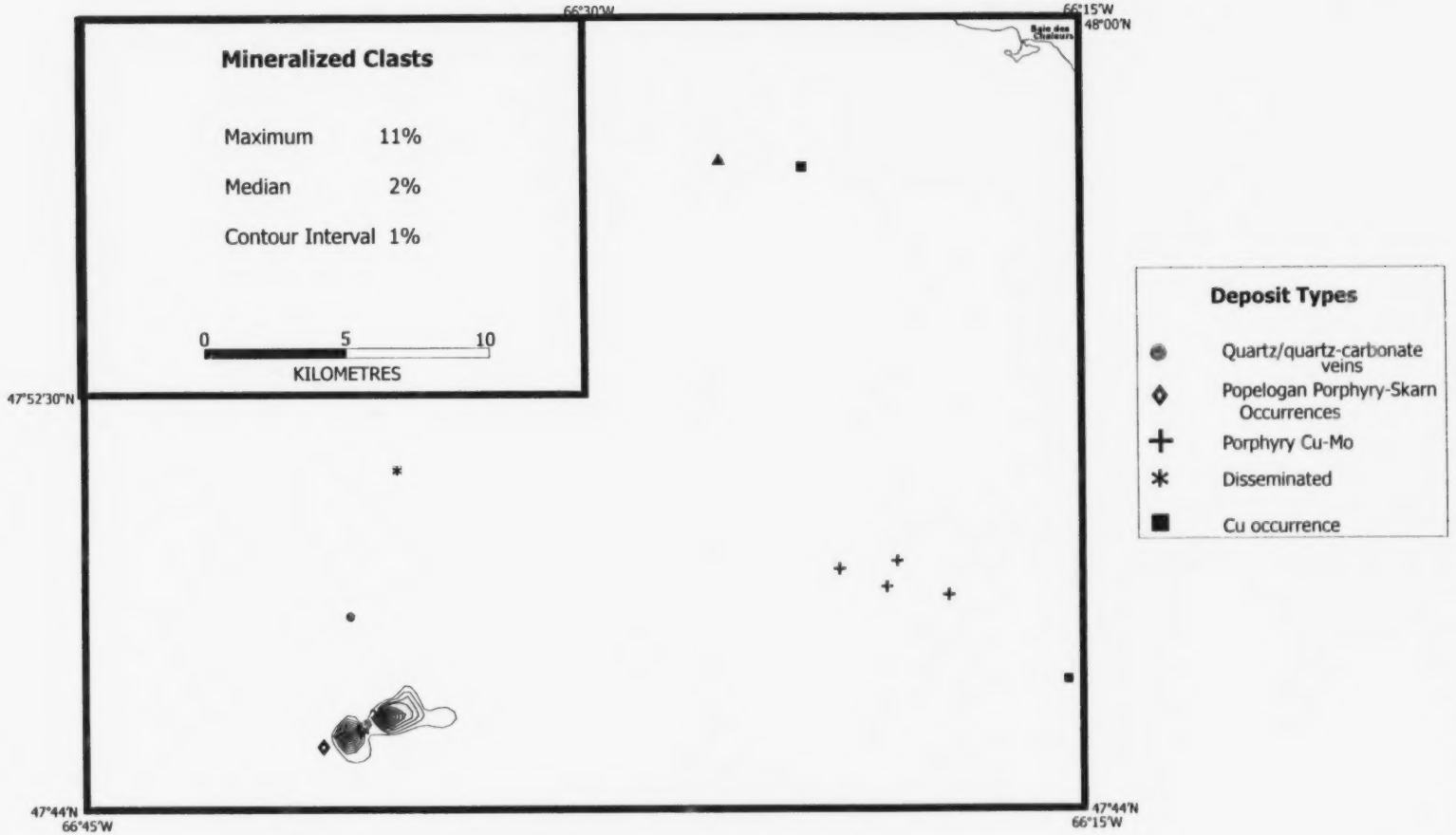



Figure 4.9: Dispersal patterns of mineralized clasts in the till matrix.

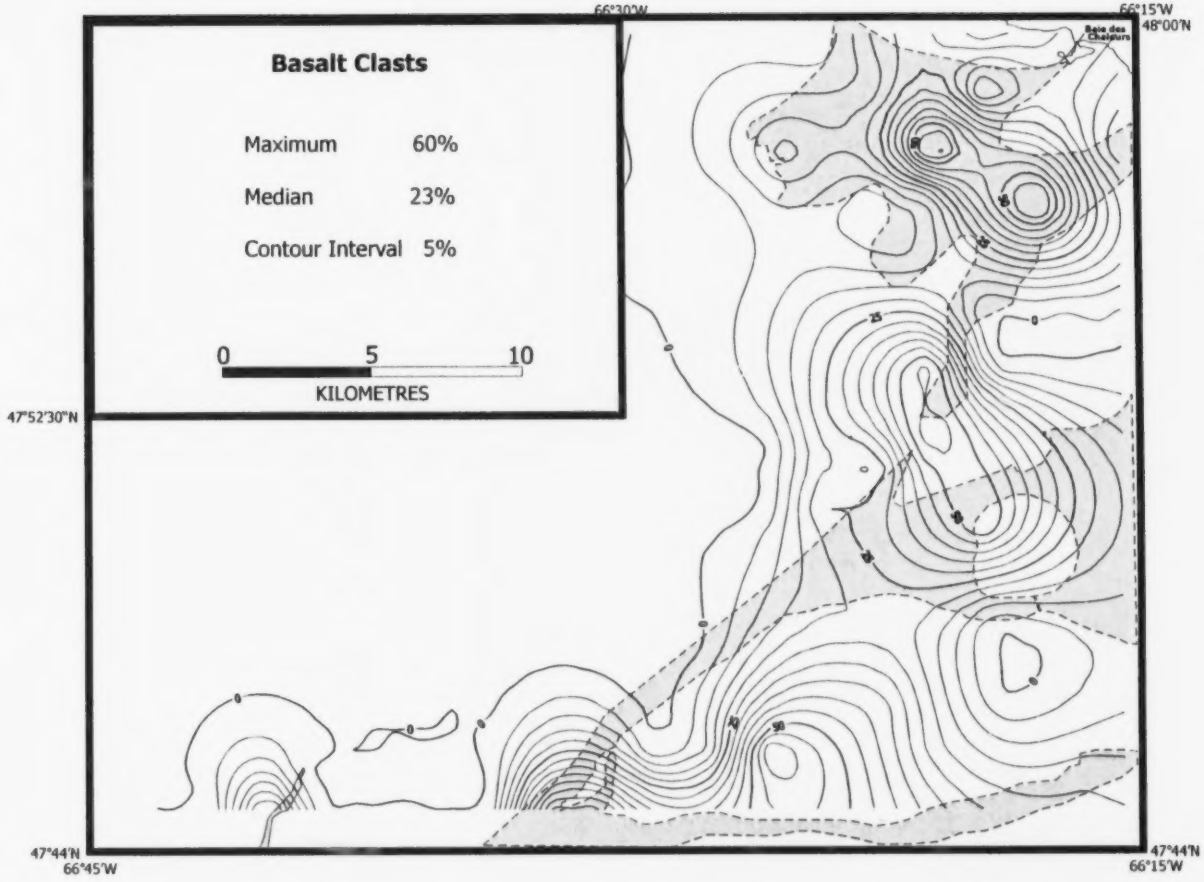



Figure 4.10: Dispersal patterns of basalt clasts in the till matrix. Shaded areas indicate possible source bedrock units (from Figure 3.2).

corner of the study area. A long (7 - 8 km) dispersal pattern extends northwestward from a point in the east-central part of the study area.

### 4.2.5 Rhyolite Clasts

Two large dispersal patterns with up to 100% rhyolite clast content (Figure 4.11) extend north-northeastward from the Benjamin Formation rhyolite (Figure 3.2) at Blue Mountain, in the southeast corner of the study area. Northwestward elongation of the western most dispersal pattern results from the lack of data in the northwest corner of the study area. Another elongate pattern (3 km) with concentrations up to 70%, extends eastward over another occurrence of Benjamin Formation rhyolite. A small bulls-eye shaped occurrence (45% rhyolite clasts) occurs in the northeast corner of the study area, 8 km northwest of the Benjamin Formation rhyolite contact. This pattern may be due to an unknown occurrence of rhyolite or incorporation of pre-glacial material.

### 4.2.6 Gabbro Clasts

Dispersal patterns of gabbro (Figure 4.12) are small and irregular in the northeast corner of the study area. A small dispersal pattern (1 km) trends east from a mafic intrusion near the Popelogan porphyryr-skarn occurrences. Another eastward-oriented dispersal pattern occurs near the contact of the Popelogan intrusion and the surrounding sedimentary rocks. A larger dispersal pattern (>4 km), in the south-central part of the study area, trends southeastward from an unknown source.

### 4.2.7 Sedimentary Clasts

Clast concentrations of sandstone and siltstone (Figure 4.13) are highest (50% to 100%) in the eastern and northeastern parts of the study area overlying rocks of the Upsalquitch Formation (Figure 3.2). Concentrations decrease (0 to 25%) to the east over the contact between the sedimentary bedrock units to the west and igneous bedrock units to the east (Figure 4.13).

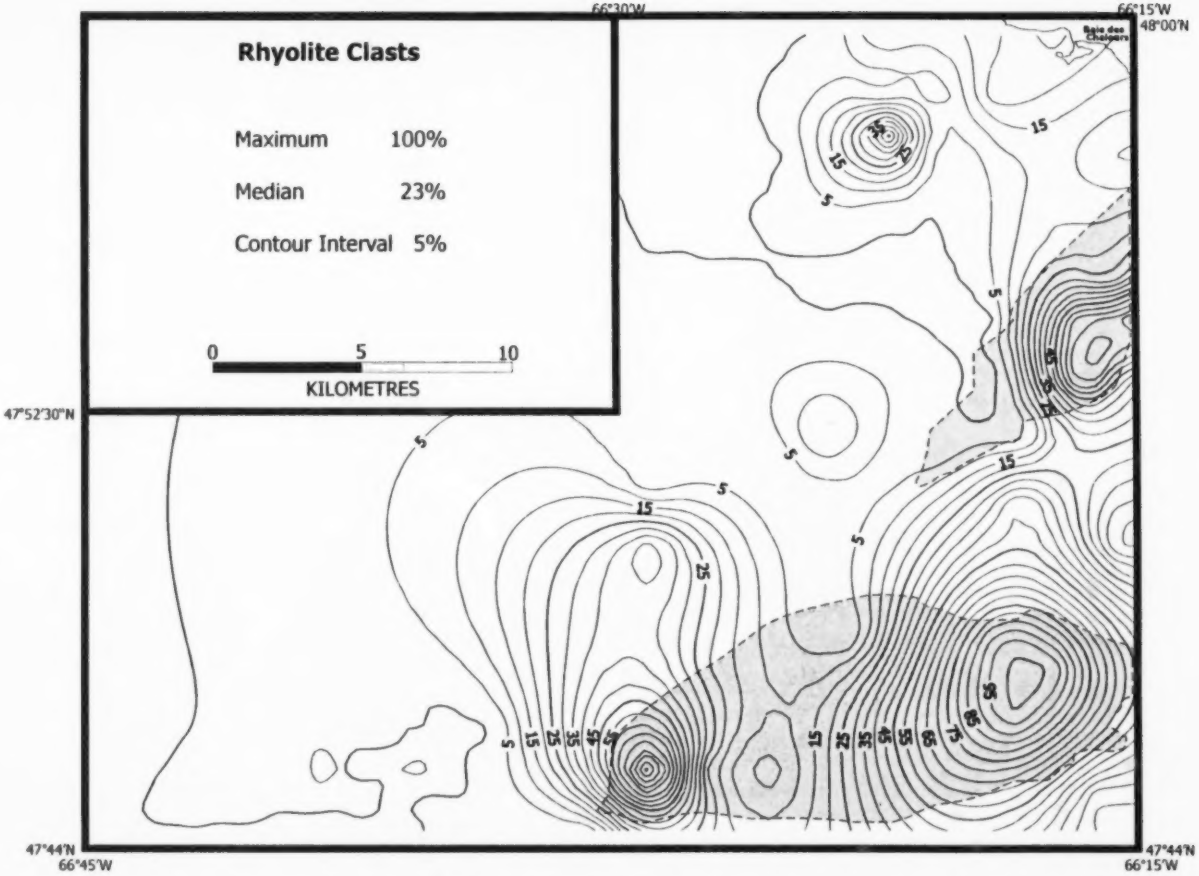



Figure 4.11: Dispersal patterns of rhyolite clasts in the till matrix. Shaded areas indicate possible source bedrock units (from Figure 3.2).

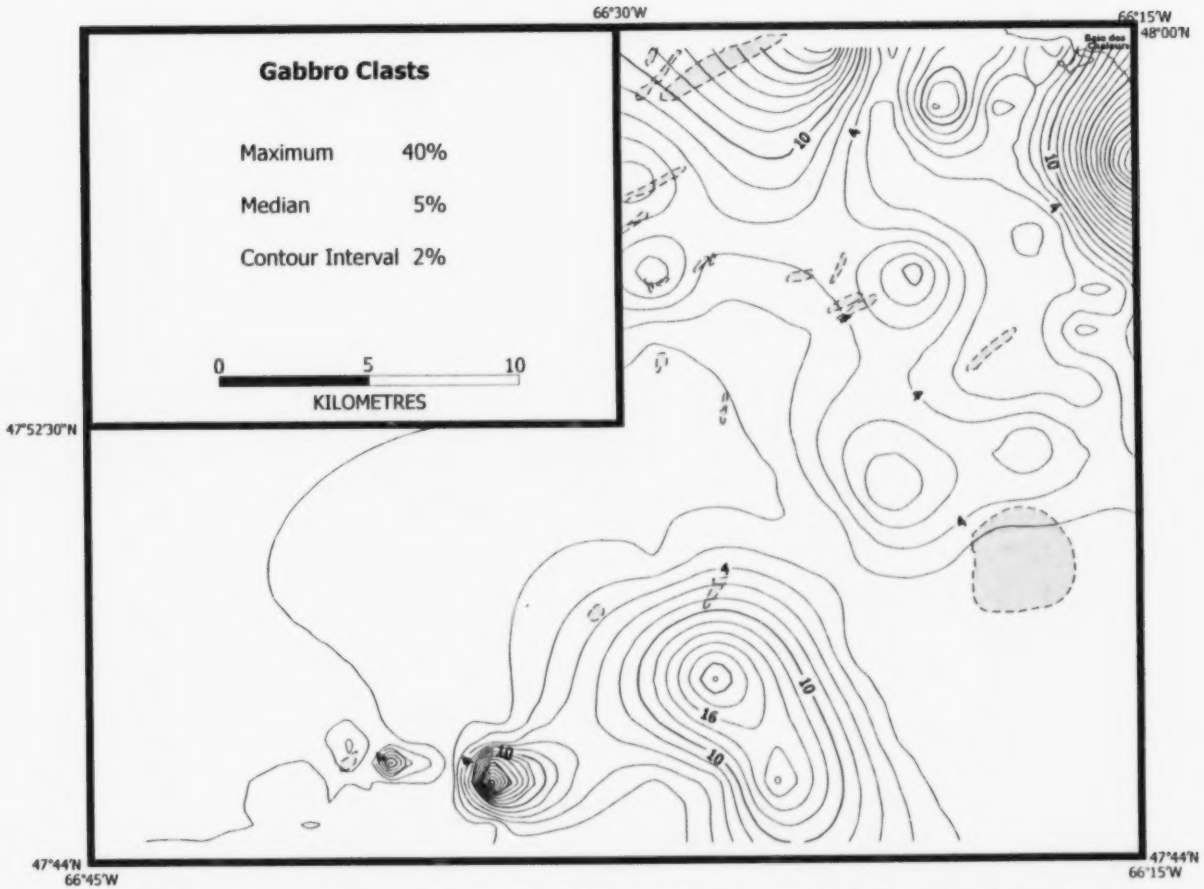



Figure 4.12: Dispersal patterns of gabbro clasts in the till matrix. Shaded areas indicate possible source bedrock units (from Figure 3.2).

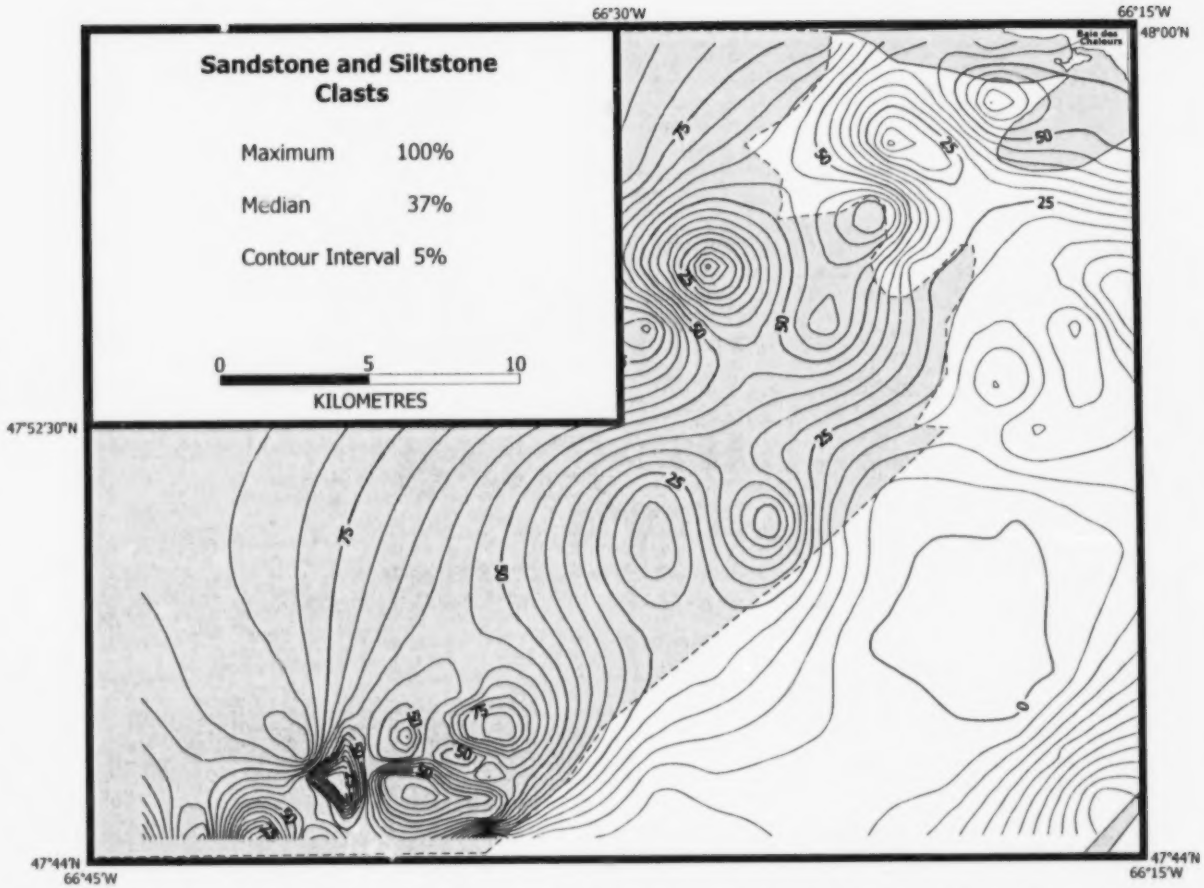



Figure 4.13: Dispersal patterns of sandstone and siltstone clasts. Thick dashed line indicates a general division between sedimentary units (shaded) and igneous units to the east (see Figure 3.2 for details on bedrock units).

Limestone clasts produce an irregular-shaped, northeast-southwest-oriented dispersal pattern with concentrations up to 91%, overlying Matapedia Group limestone in the southwest corner (Figure

4.14). Clast concentrations of up to 78% form a northwestward-oriented dispersal pattern in the northeast corner over rocks of the La Vielle Formation (Figure 3.2).

## 4.3 Granulometric Analyses

The sand, silt, and clay concentrations of the till matrix samples generally reflect the nature of the underlying bedrock and sedimentary deposits. On average, till matrices in the study area contain approximately equal amounts of sand and silt, with small amounts of clay (Appendix II and Appendix VI). Sand concentrations tend to be higher (50% - 80%) over sandstone/siltstone units and igneous units (Figure 4.15) in the area. Sand content forms a concentration pattern (50% - 70%), elongated northeast, possibly from the incorporation of granitic material from an intrusion in the southwest corner of the study area. Smaller patterns, with similar concentrations (50% - 70%), originate over rhyolite and basalt bedrock in the northeast part of the study area.

Silt concentrations of up to 50% - 60% (Figure 4.16) correlate with lower concentrations of sand. Lower concentrations of silt (40% - 60%) form an elongated pattern northward from a point over the Benjamin Formation rhyolite (Figure 3.2) in the southeast corner of the study area.

Clay concentrations are low throughout the study area, with slightly higher concentrations (14%) in the southwestern corner of the study area (Figure 4.17). The highest concentration (35%) occurs over sandstone and siltstone of the Upsalquitch Formation (Figure 3.2) near the Baie des Chaleurs coast and may represent incorporation of underlying glaciomarine deposits from a previous period of submergence.

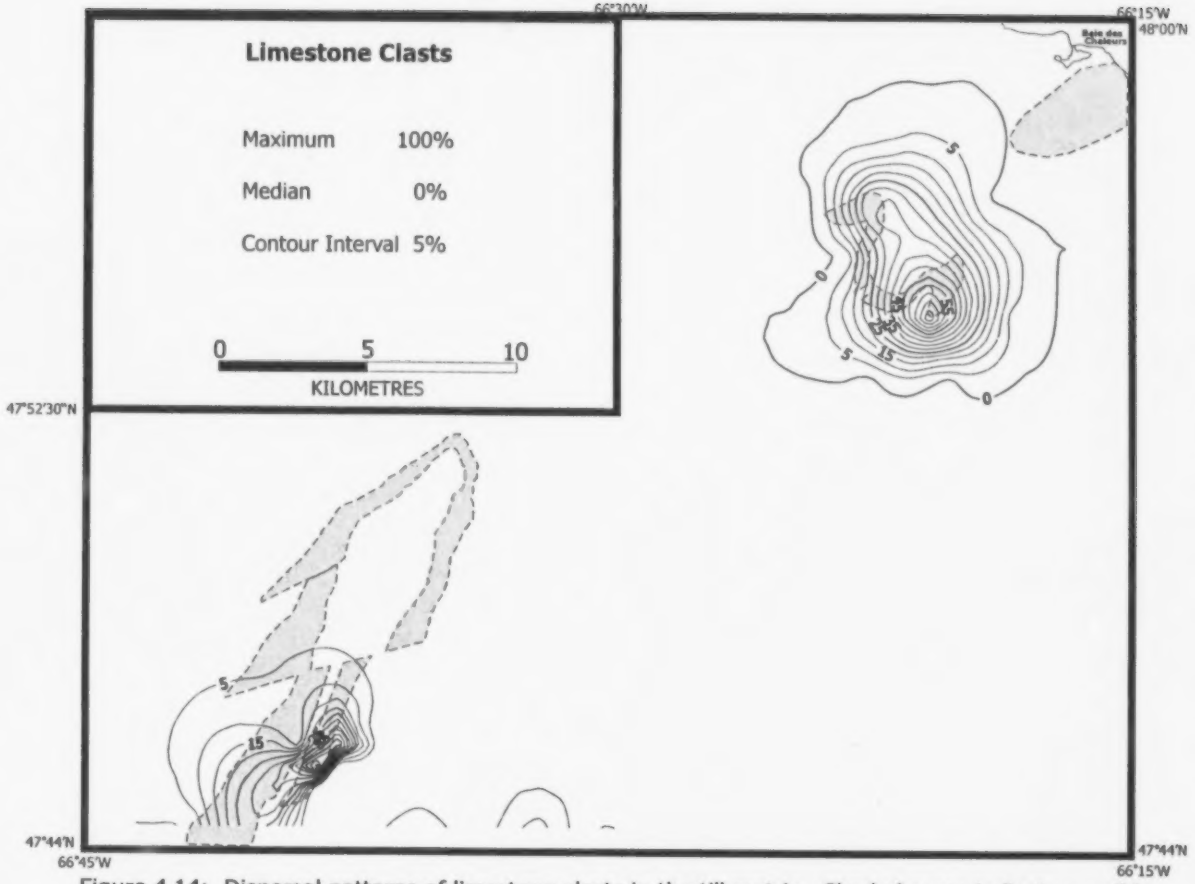



Figure 4.14: Dispersal patterns of limestone clasts in the till matrix. Shaded areas indicate possible source bedrock units (from Figure 3.2).

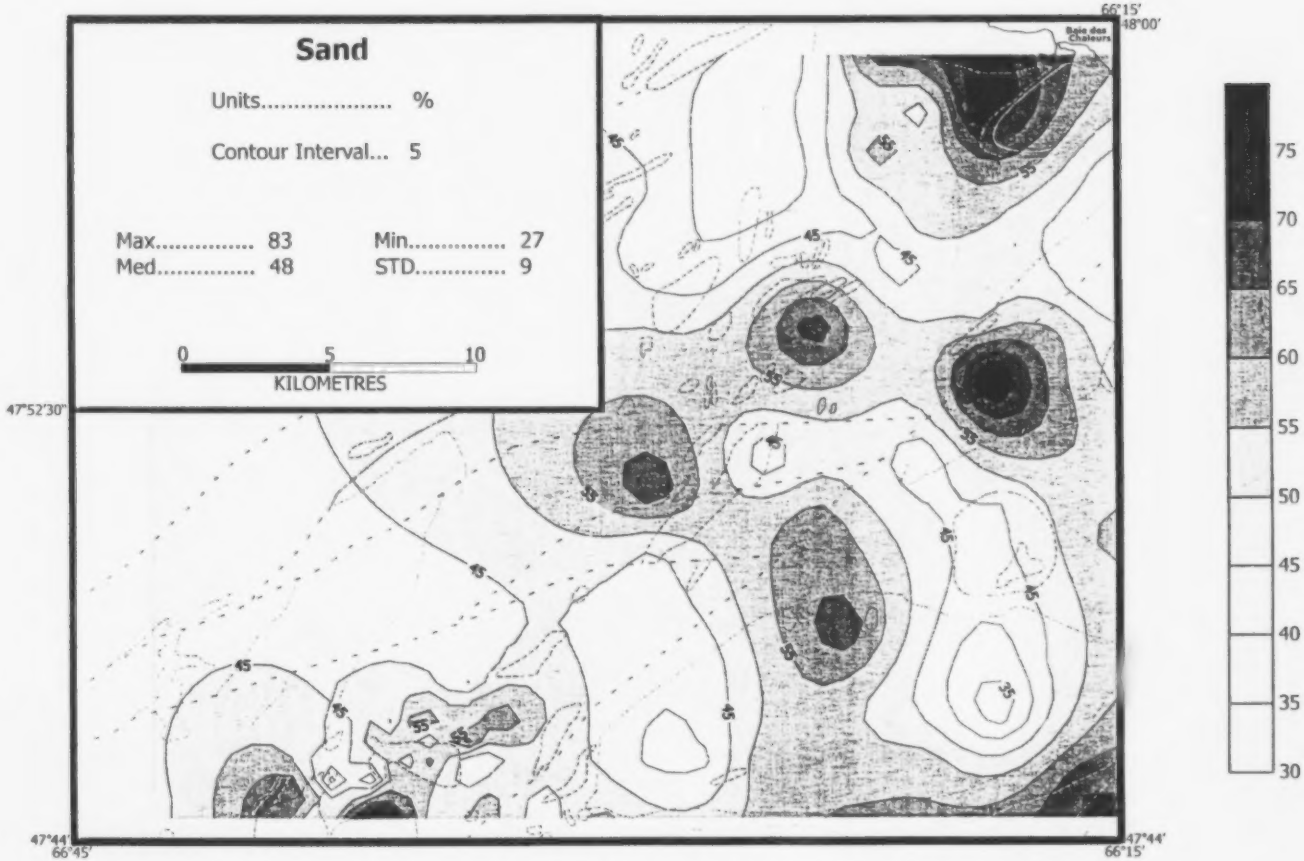



FIGURE 4.15: Patterns of sand content in the till matrix. Bedrock units are outline by dashed lines (from Figure 3.2).

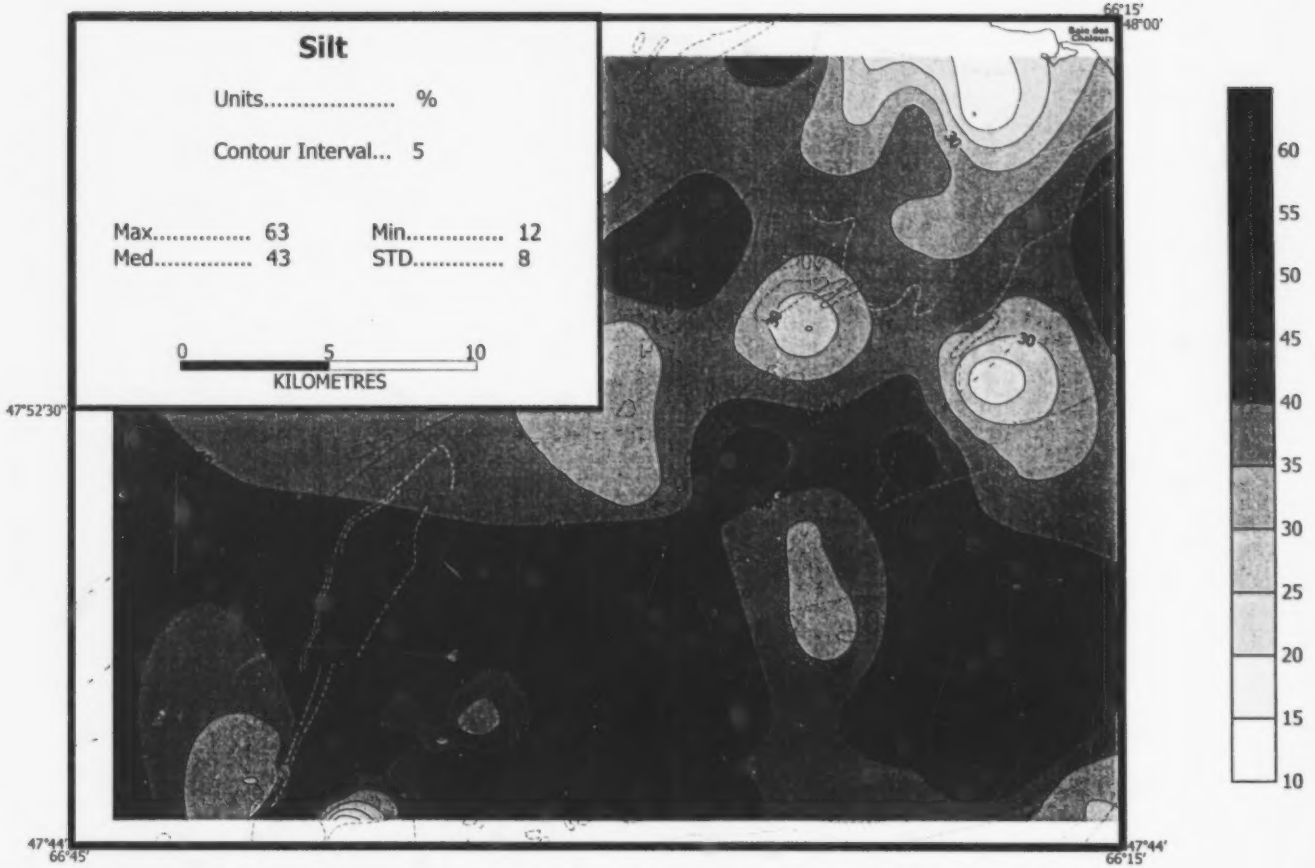



FIGURE 4.16: Patterns of silt content in the till matrix. Bedrock units are outline by dashed lines (from Figure 3.2).

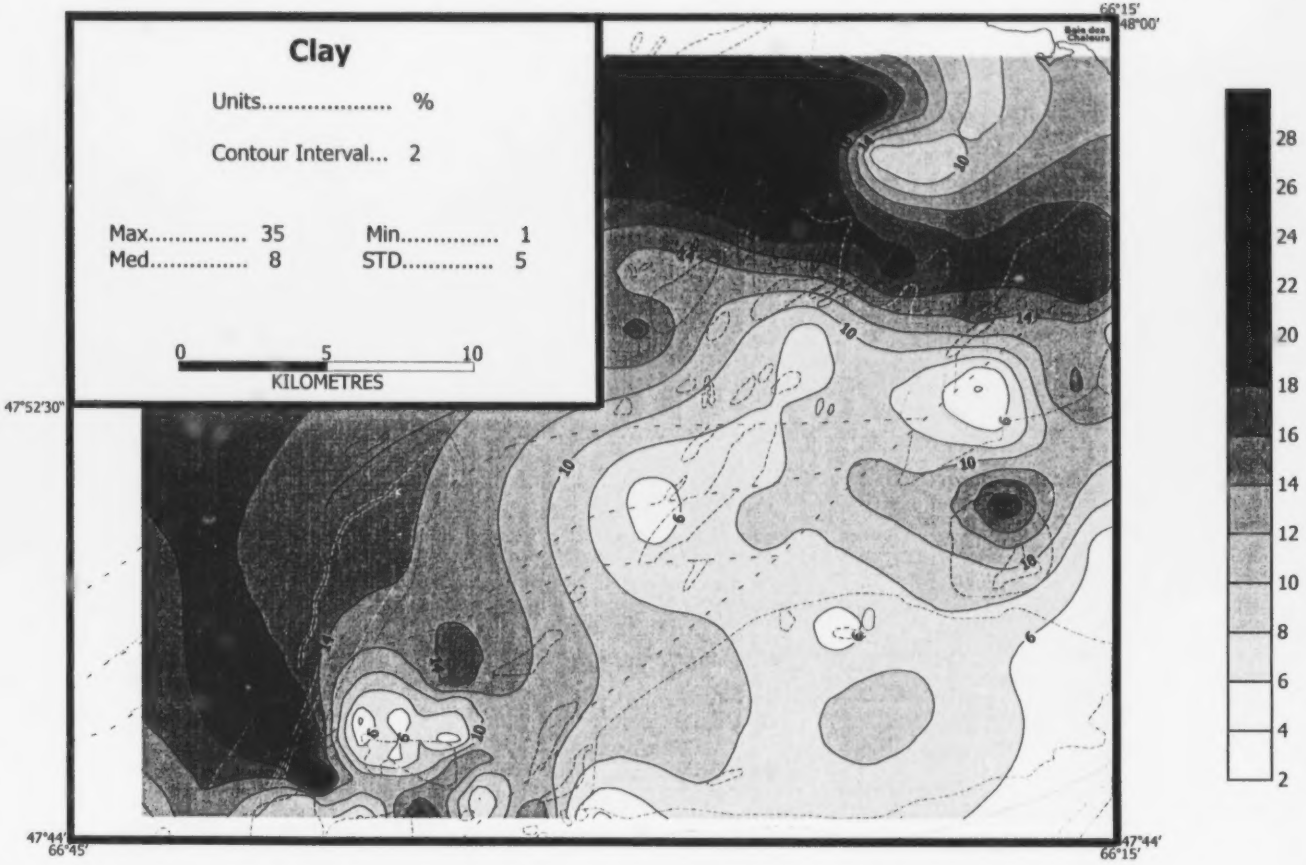



FIGURE 4.17: Patterns of clay content in the till matrix. Bedrock units are outline by dashed lines (from Figure 3.2)

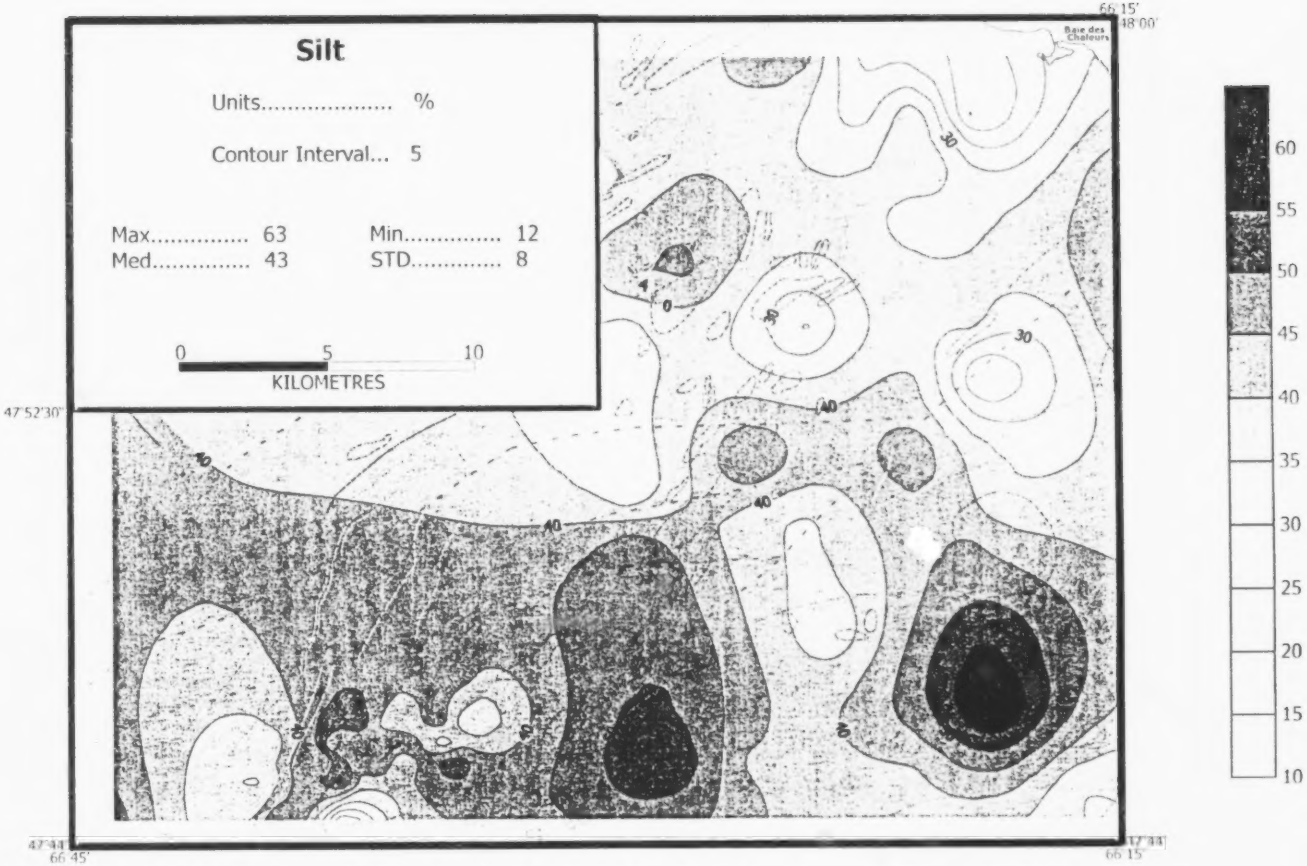



FIGURE 4.16: Patterns of silt content in the till matrix. Bedrock units are outline by dashed lines (from Figure 3.2).

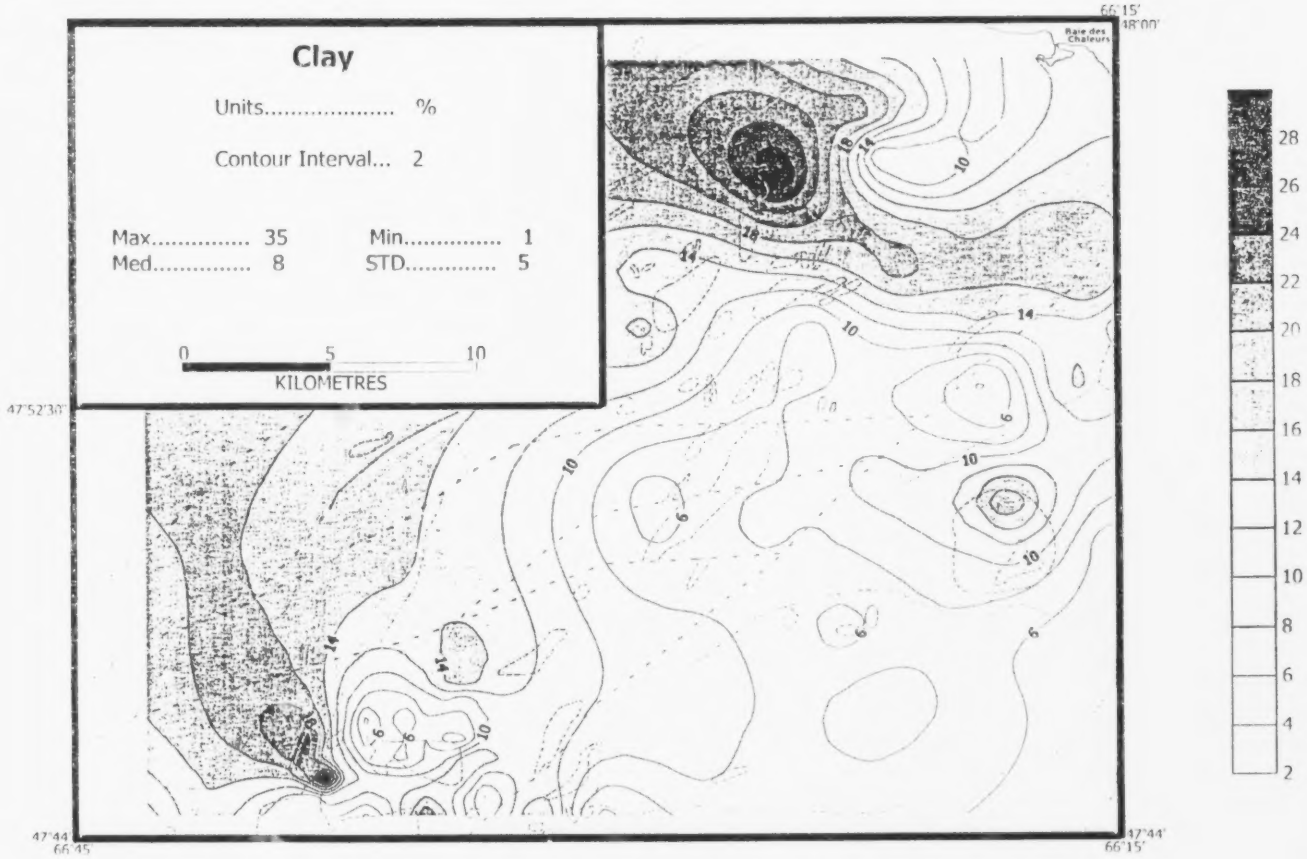



FIGURE 4.17: Patterns of clay content in the till matrix. Bedrock units are outline by dashed lines (from Figure 3.2)

## 4.4 Geochemical Analysis

Till matrix and humus samples were analyzed for a total of 39 different elements (base metals, trace elements, and rare earth elements; Appendix IV). The accuracy and precision of the geochemical analyses were monitored using standards, lab, and field duplicates (Appendix V). Experimental values were compared with accepted values for standards, while duplicates were compared with each other.

Median values for individual elements were taken as regional background levels (Appendix VI). Anomalous values were based on threshold values outside two standard deviations from the median value. This includes the upper 95.44$^{th}$ percentile of the data set, assuming the data follow a normal distribution. The lower 4.66$^{th}$ percentile was not evaluated during this study due to poor instrumentation response at lower concentrations.

### 4.4.1 Till

Geochemical data for most elements in the till matrix were contoured and examined on regional-scale maps for general dispersal trends. Detailed examinations of dispersal patterns of Ag, As, Cu, Mo, Pb, W, and Zn were carried out in the area of the Popelogan porphyryr-skarn Cu-Zn-Pb occurrences (Figure 3.3) and used to model dispersal from unknown occurrences.

#### 4.4.1(i) Silver (Ag)

Elevated values (>2 ppm) of silver are associated with the Popelogan and Popelogan East occurrences, with a dispersal pattern, approximately 4 km long, trending to the east-northeast (Figure 4.18). Slightly elevated values form a smaller northeast-trending dispersal pattern to the south of the Popelogan South occurrence. Another northeastward-trending dispersal pattern, approximately 3 km in length, occurs to the south of the Popelogan Lake occurrence. A bulls-eye anomaly occurs to the southwest of the Benjamin River South D base-metal (Cu-Mo) occurrence.

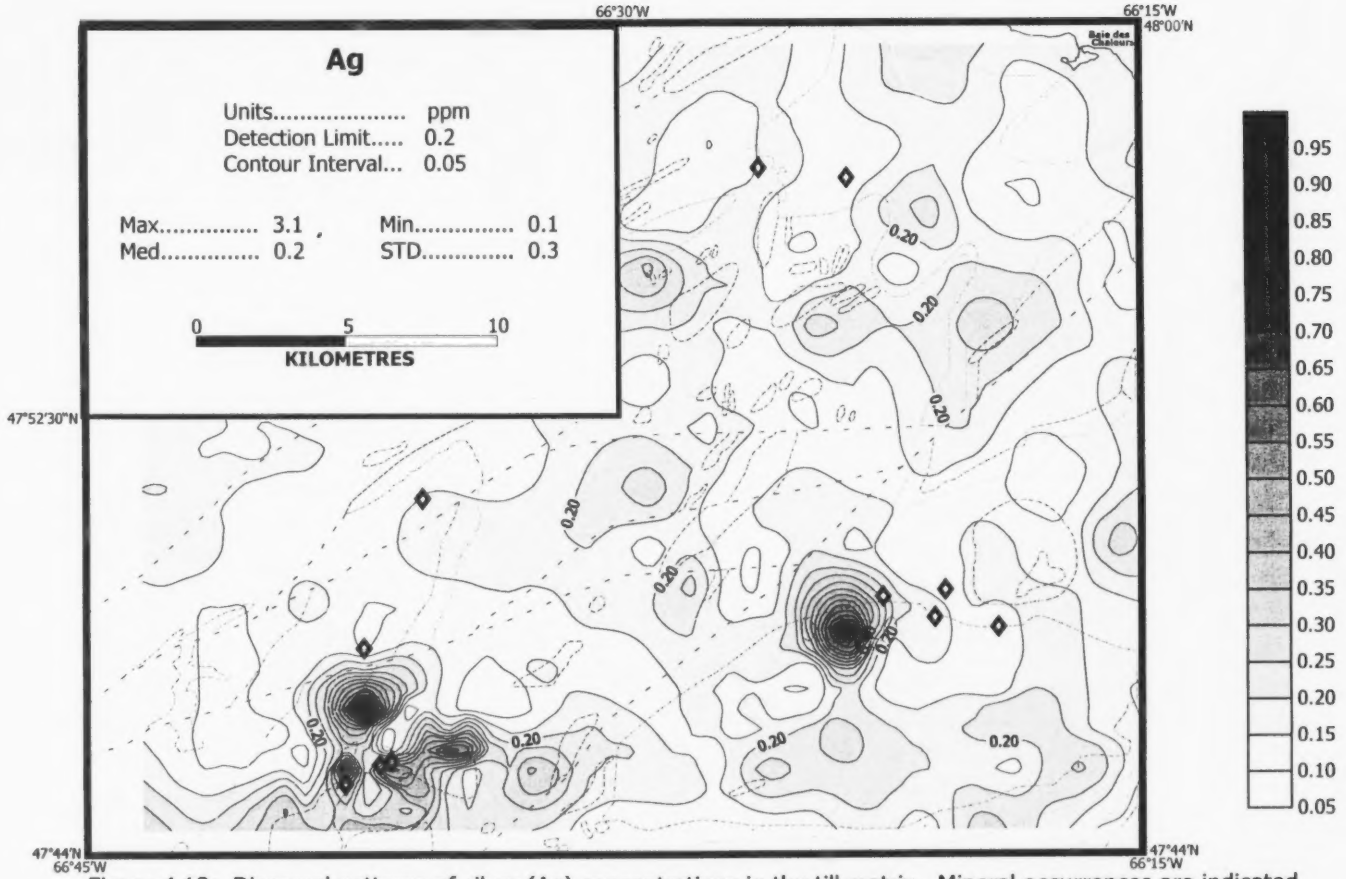



Figure 4.18: Dispersal patterns of silver (Ag) concentrations in the till matrix. Mineral occurrences are indicated by the diamond shape (from Figure 3.3) and bedrock units are outlined by dashed lines (from Figure 3.2)

4.4.1(ii) Arsenic (As)

Dispersal of arsenic is short and irregularly shaped, with elevated values occurring just south of the Popelogan South occurrence (Figure 4.19). Two anomalous (>30 ppm) areas in the northeast of the study area appear to be associated with the contact between the Devonian felsic intrusions and the Silurian metasedimentary rocks. Dispersal patterns trend towards the northeast for approximately 3 km. A smaller dispersal pattern, trending east-northeast, in the central part of the study area is associated with an eastward-trending fault.

4.4.1(iii) Copper (Cu)

Bulls-eye anomalies (630 ppm) of copper occur directly below the Popelogan and Popelogan East occurrences (Figure 4.20). A small dispersal pattern (< 2 km) is elongated eastward just east of Popelogan East. Both the dispersal pattern and the bulls-eye anomalies are slightly attenuated to the north. A short (<1 km) eastward-trending dispersal pattern occurs in association with an eastward-trending fault in the central part of the study area.

4.4.1(iv) Molybdenum (Mo)

A small (2 km) dispersal pattern of molybdenum is associated with the Popelogan South occurrence, trending northeast (Figure 4.21). A smaller coincident dispersal pattern trends eastward from the northeastward dispersal pattern. A bulls-eye anomaly (14 ppm) occurs just south of the Popelogan intrusion. A second bulls-eye anomaly (12 ppm) occurs in the central part of the study area, coincident with the Cu dispersal. A third anomaly occurs in the northwest edge of the study area.

4.4.1(v) Lead (Pb)

Anomalous values (133 ppm) of lead (Pb) occur directly below the Popelogan South occurrence (Figure 4.22). Small dispersal patterns trending north-northeast occur on the southern

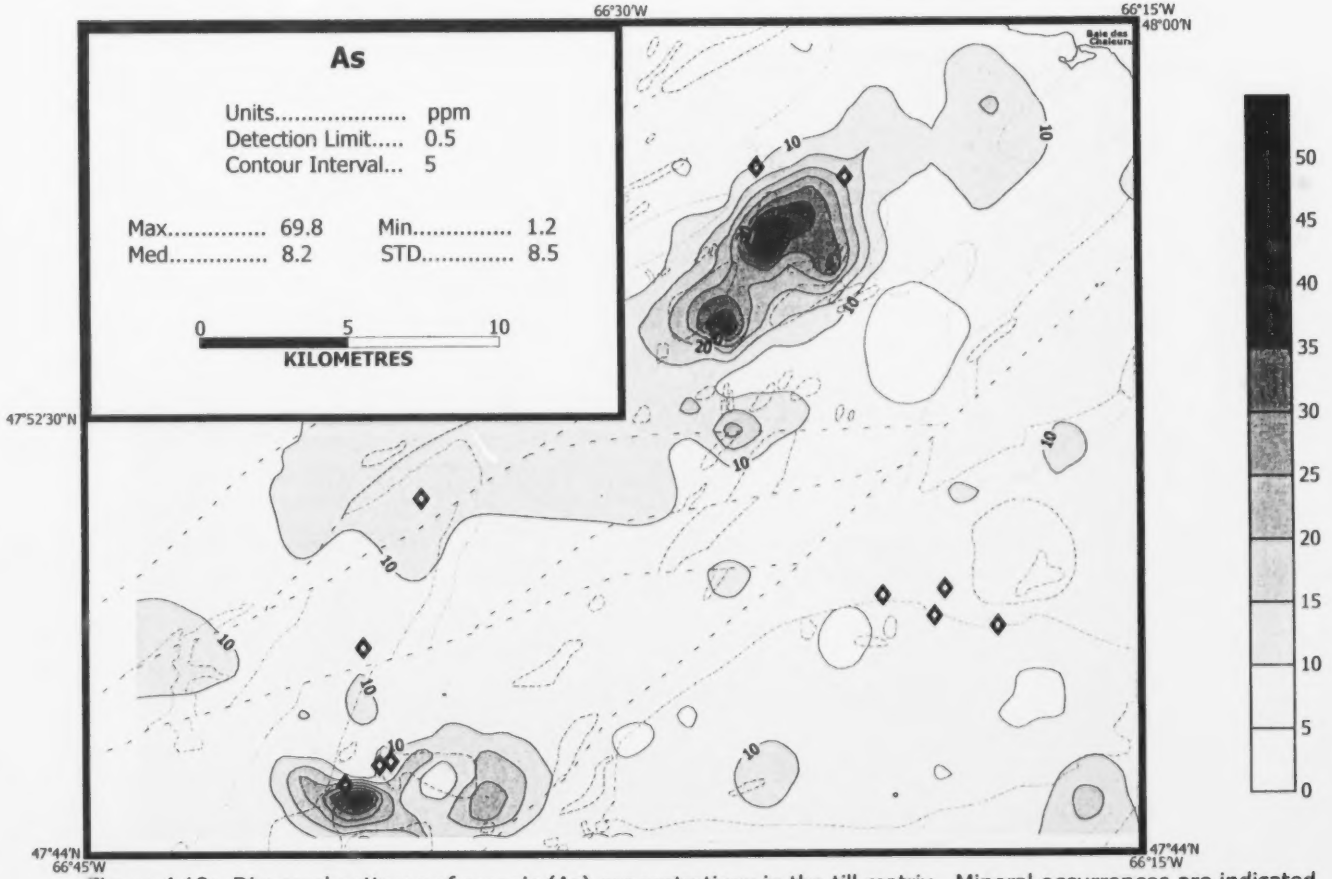



Figure 4.19: Dispersal patterns of arsenic (As) concentrations in the till matrix. Mineral occurrences are indicated by the diamond shape (from Figure 3.3) and bedrock units are outlined by dashed lines (from Figure 3.2).

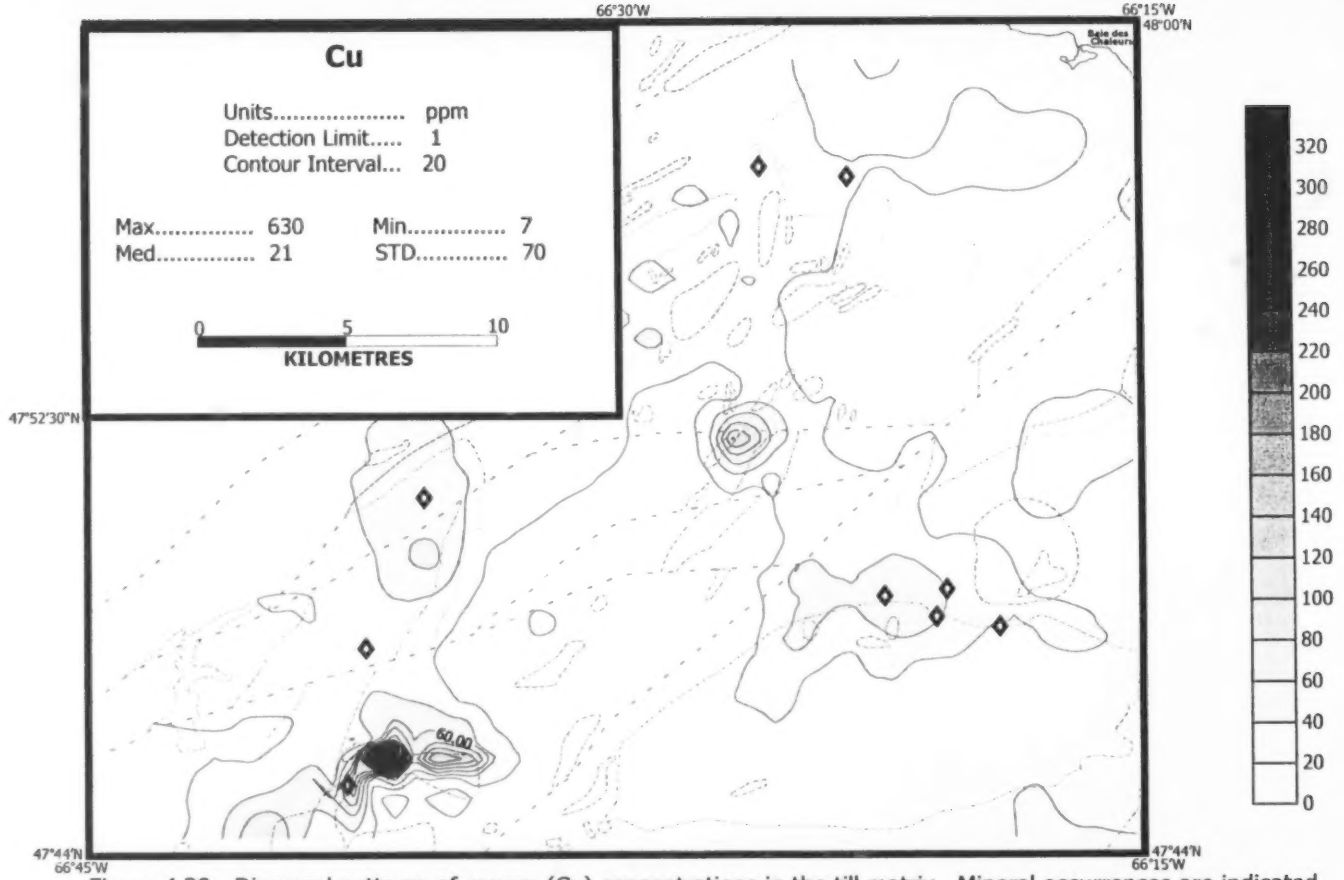



Figure 4.20: Dispersal patterns of copper (Cu) concentrations in the till matrix. Mineral occurrences are indicated by the diamond shape (from Figure 3.3) and bedrock units are outlined by dashed lines (from Figure 3.2).

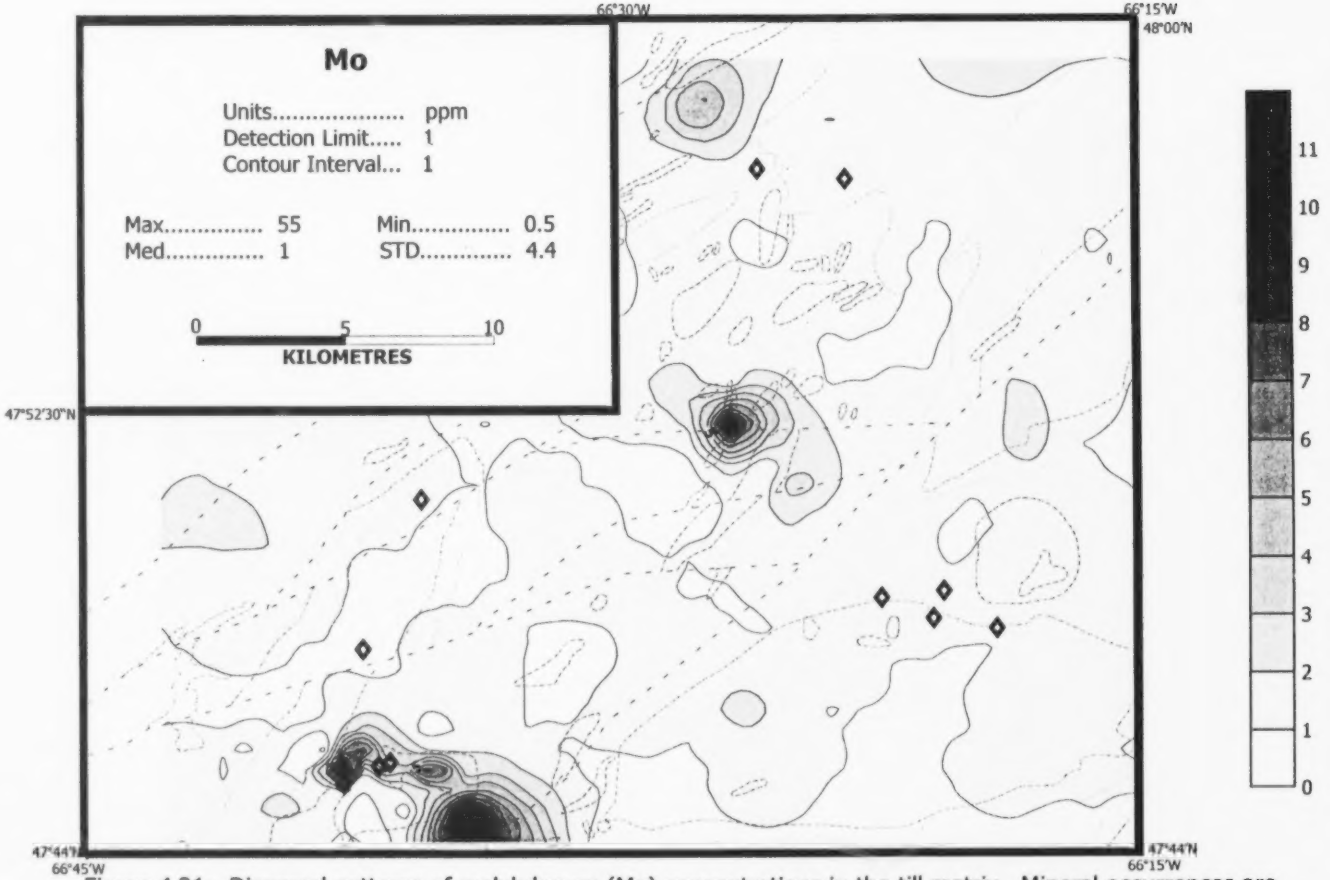



Figure 4.21: Dispersal patterns of molybdenum (Mo) concentrations in the till matrix. Mineral occurrences are indicated by the diamond shape (from Figure 3.3) and bedrock units are outlined by dashed lines (from Figure 3.2).

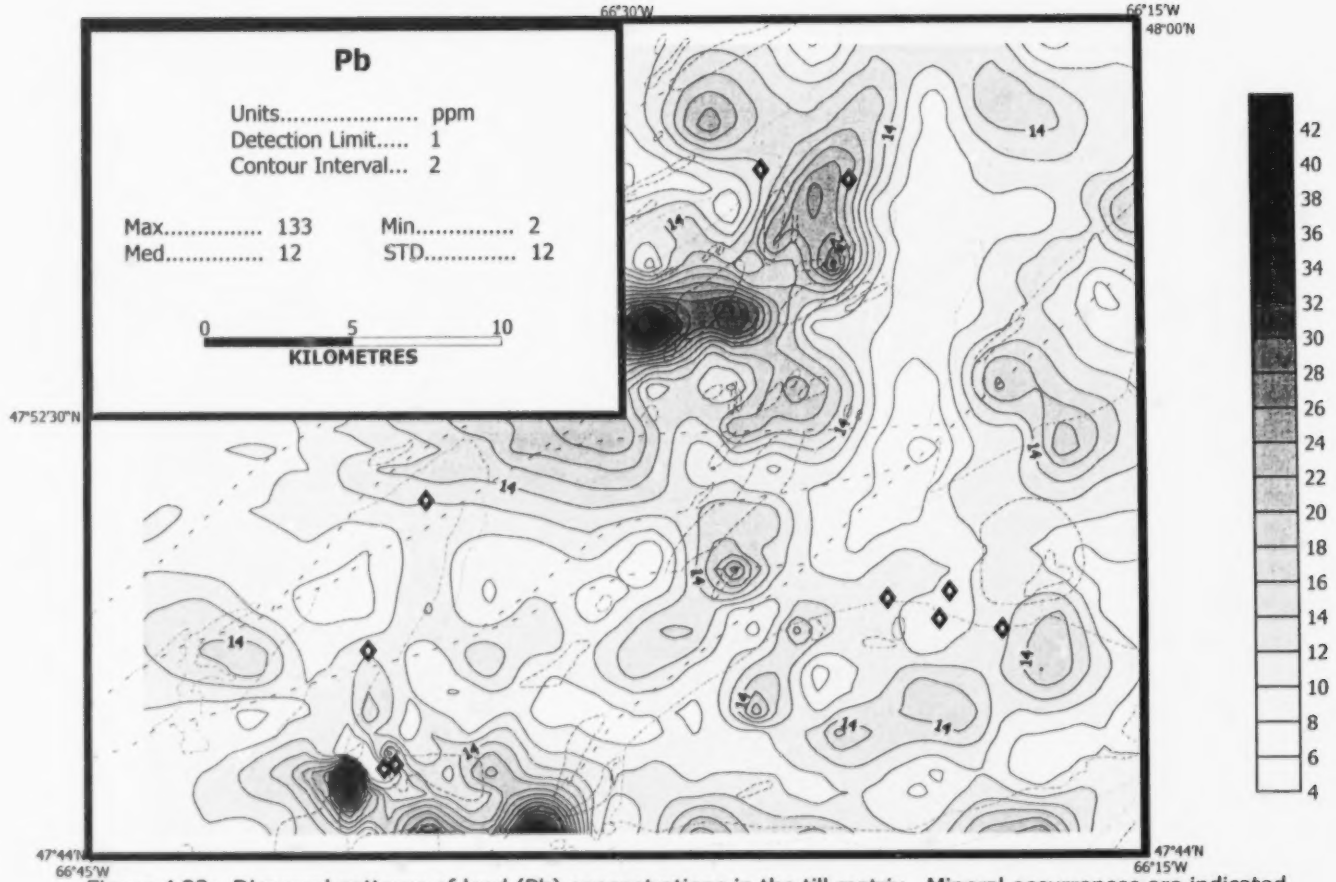



Figure 4.22: Dispersal patterns of lead (Pb) concentrations in the till matrix. Mineral occurrences are indicated by the diamond shape (from Figure 3.3) and bedrock units are outlined by dashed lines (from Figure 3.2).

margin of the study area. Elevated values of Pb (>40 ppm) form an eastward dispersal pattern in the north-central part of the area.

4.4.1(vi) Tungsten (W)

The highest concentration (67 ppm) of tungsten (W) occurs to the north-northeast of the Popelogan South occurrence, trending eastward (Figure 4.23). Other elevated values occur in association with the Benjamin River South B occurrence, and with a fault in the central part of the study area.

4.4.1(vii) Zinc (Zn)

Anomalous values of zinc (Zn) occur directly below the Popelogan South occurrence (Figure 4.24). A small (4 km), northeastward-trending, dispersal pattern occurs in the north-central part of the study area, with concentrations greater than 140 ppm. A small, irregularly shaped dispersal pattern occurs in the southeastern corner of the area, southeast of the Benjamin River South C occurrence.

4.4.2 Humus

Elemental concentrations of 109 humus samples were compared by statistical correlation (Section 4.5) to the analyses of samples taken from till at the same sample sites. Humus samples generally exhibit lower mean concentrations for the majority of elements analyzed, compared to till matrix samples. Silver, Cd, Hg, Mn, Pb, and Zn were the only elements that show significantly higher mean concentrations in the humus samples, relative to samples from the underlying till (Appendix VI: Table II). The higher concentrations of Ag (5x) , Cd (6x), Hg (4x), Mn (9x), Pb (5x), and Zn (2x) in humus may be attributed to the greater capacity of humus to adsorb cations and/or form complexes with these metals (Fitzpatrick, 1986) relative to the till matrix. Concentrations are not, however, consistently higher in humus and lower in the till matrix for every sample. Also, maximum metal (Ag, Cd, Hg, Mn, Pb, and Zn) concentrations in humus do not correspond with either

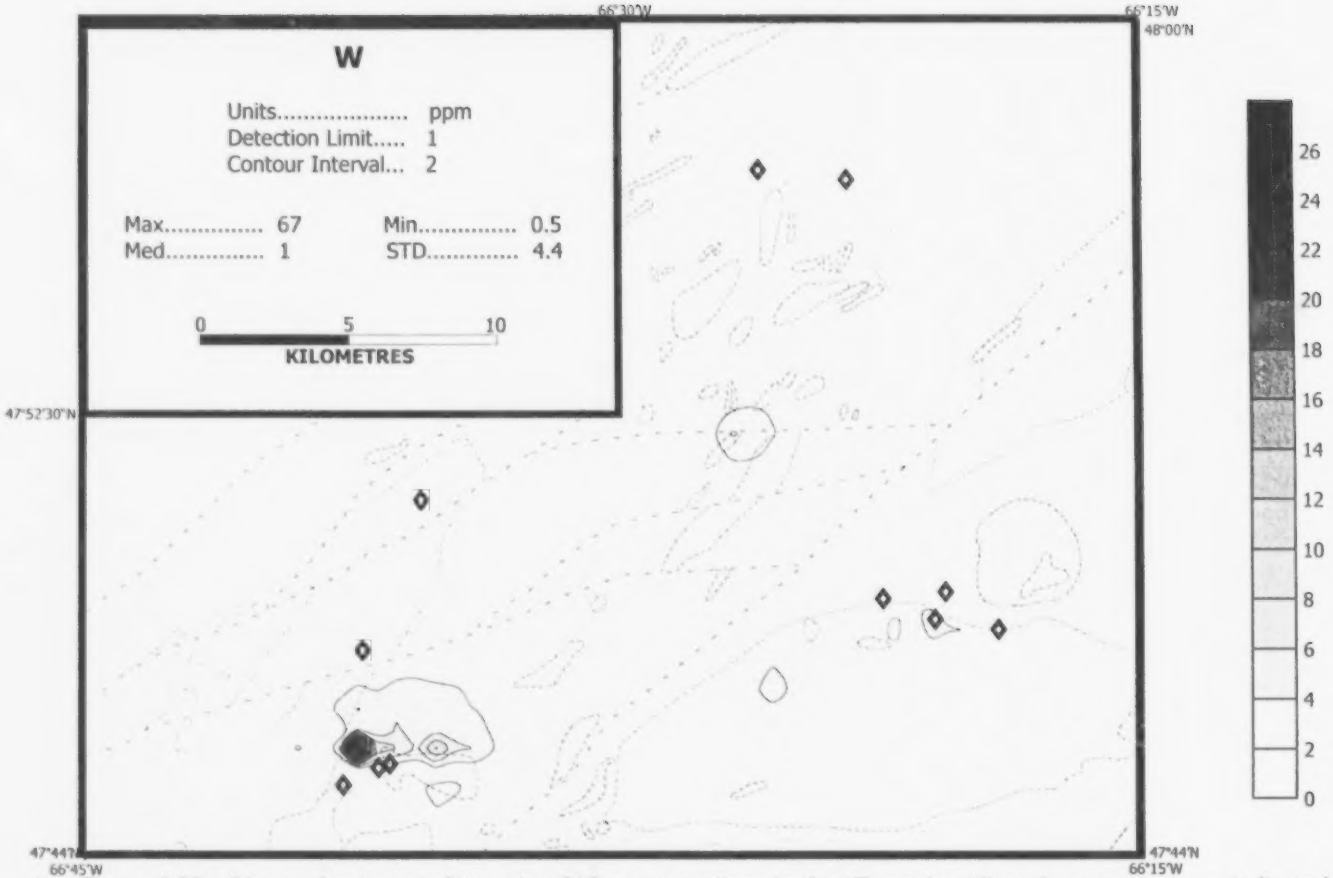



Figure 4.23: Dispersal patterns of tungsten (W) concentrations in the till matrix. Mineral occurrences are indicated by the diamond shape (from Figure 3.3) and bedrock units are outlined by dashed lines (from Figure 3.2).

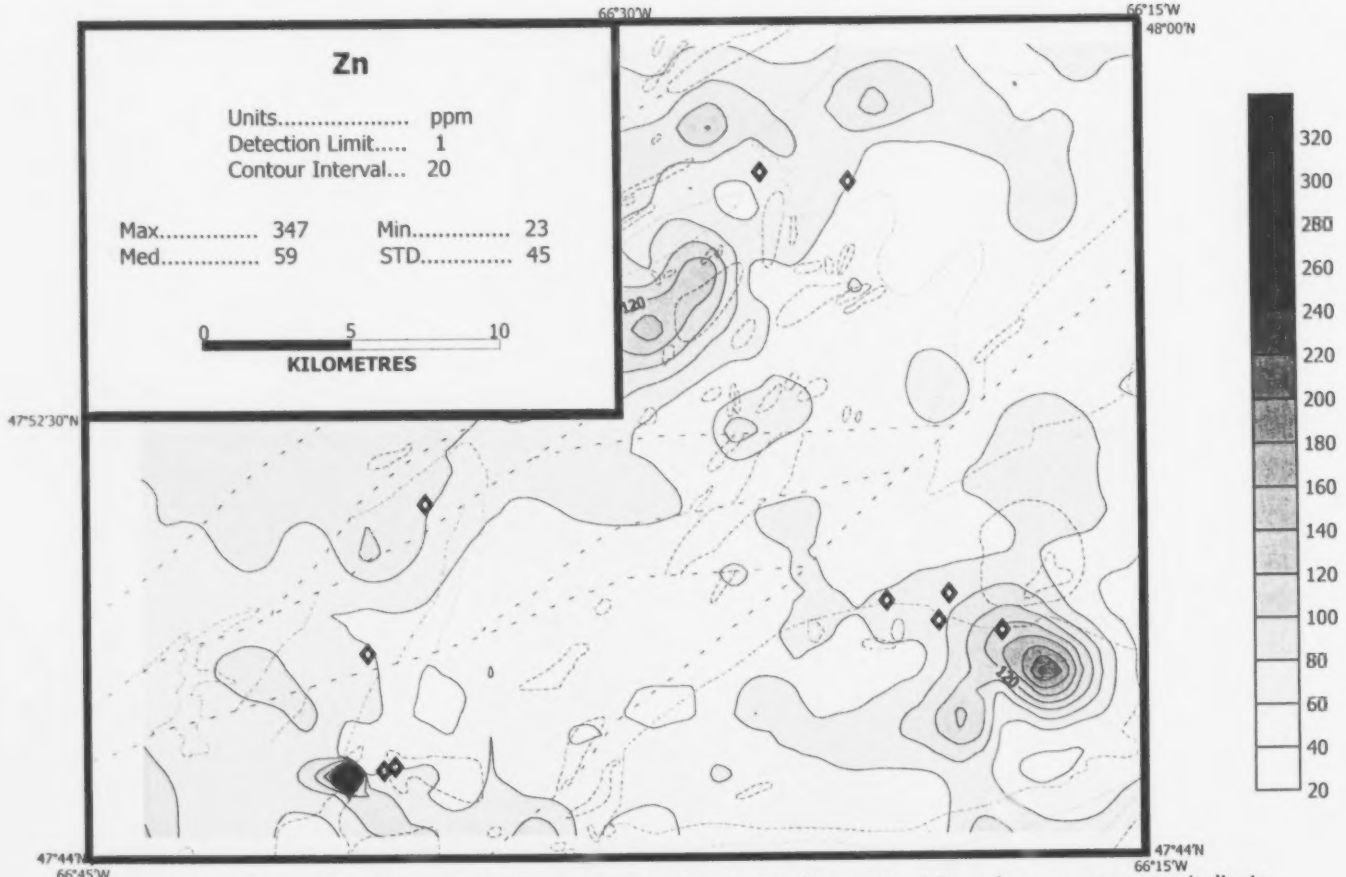



Figure 4.24: Dispersal patterns of zinc (Zn) concentrations in the till matrix. Mineral occurrences are indicate by the diamond shape (from Figure 3.3) and bedrock units are outlined by dashed lines (from Figure 3.2).

maximum or minimum concentrations in till. Elemental concentration patterns for Ag, Cd, Hg, Mn, Pb, and Zn in humus are larger than those exhibited by the till matrix (Figures 4.25 - 4.30), thus forming large areal geochemical exploration targets. The concentration patterns of humus samples demonstrate a general area of high concentration for the metals, but not a defined point source.

## 4.5 Statistical Correlations: Spearman's Rank Correlation Coefficient

The Spearman's rank correlation analysis is a nonparametric statistical technique used to quantify the strength of association between two variables with non-normal or skewed distributions (McGrew and Monroe, 1993). Data discussed herein were compared using the Statistical Package for the Social Sciences, version 10 (SPSS 10 for Windows®). Geochemical data were compared for all samples analyzed in the study (Table 4.3).

False correlations, termed 'closure', can arise when comparing data sets which sum to a fixed value (i.e. 100% for granulometric and lithological data)( Silk, 1979; Broster, 1982). Closure implies that data sets will display some degree of correlation, irrespective of the relationship between variables. In this study, sand and silt exhibit a strong negative correlation (-0.793), suggesting a degree of association between these variables; however, the influence of closure may overstate the magnitude of this correlation. It is, however, possible that this correlation is reflecting the process of glacial comminution (Broster, 1982).

Geochemical elements associated with the Popelogan porphyryr-skarn occurrences (Ag, As, Cu, Mo, Pb, W, and Zn) exhibit weak correlations ($r<0.56$) with each other, with the exception of a moderately strong correlation between As and Pb ($r=0.67$). Statistically significant correlations (Table 4.3) exist between some transition metals (Fe with Hf ($r=-0.78$) and Ni ($r=0.65$); Co with Mn ($r=0.63$); and Cr with Ni ($r=0.78$)) and rare earth elements (Sm with Ce ($r=0.65$) and Tb ($r=0.70$)). Bromine and mercury exhibit a moderately strong correlation ($r=0.70$), which may be associated with anomalous values of both elements overlying rhyolitic bedrock and granitic intrusions (Appendix V: Figure I and II). No correlations are apparent between geochemical and lithological data, or

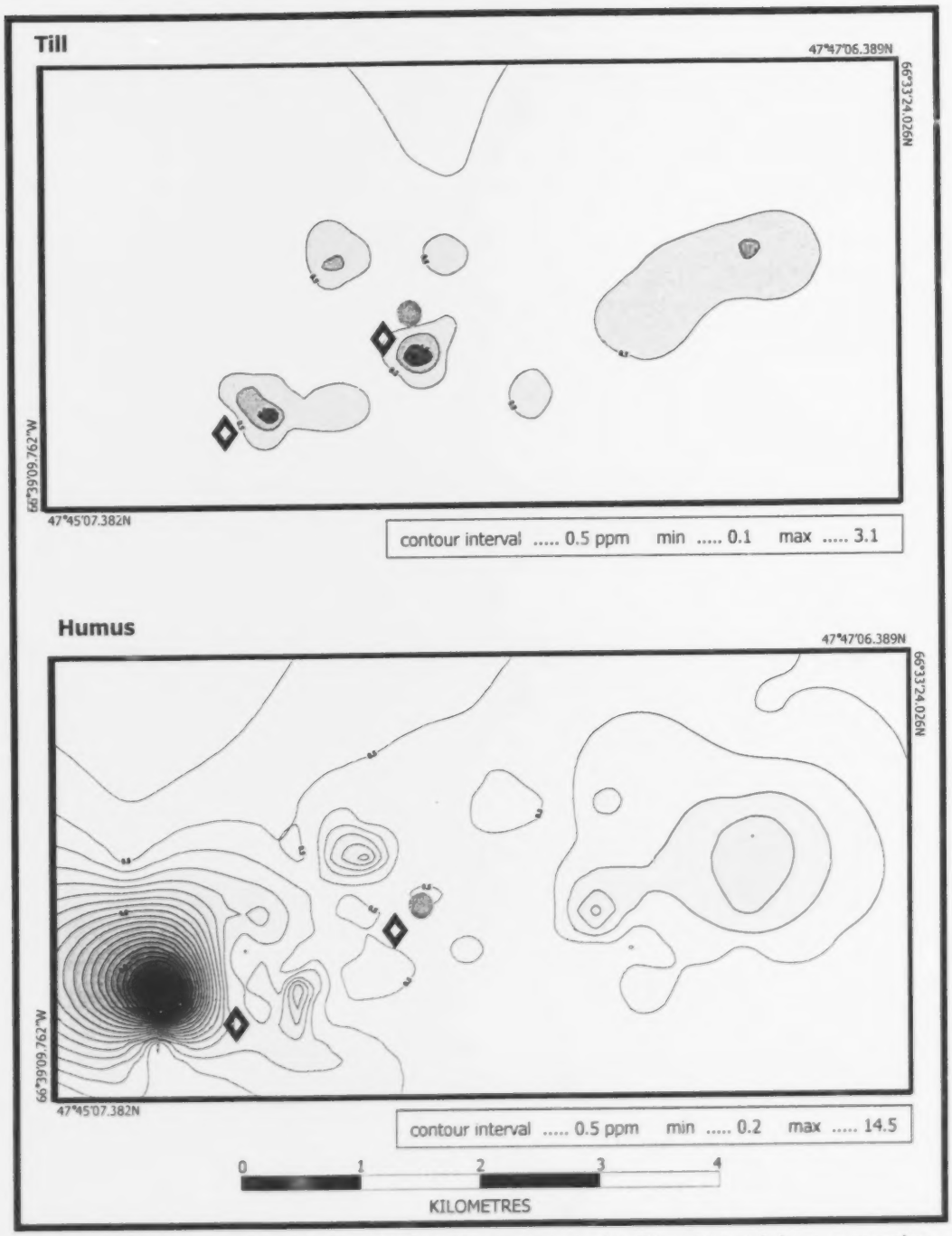



Figure 4.25: Comparison of silver (Ag) concentrations in the till matrix with humus samples collected at the same site. Diamond and circle shapes indicate the Popelogan mineral occurrences (from Figure 3.2). Area of study is outlined in Figure 2.1 and 2.2.

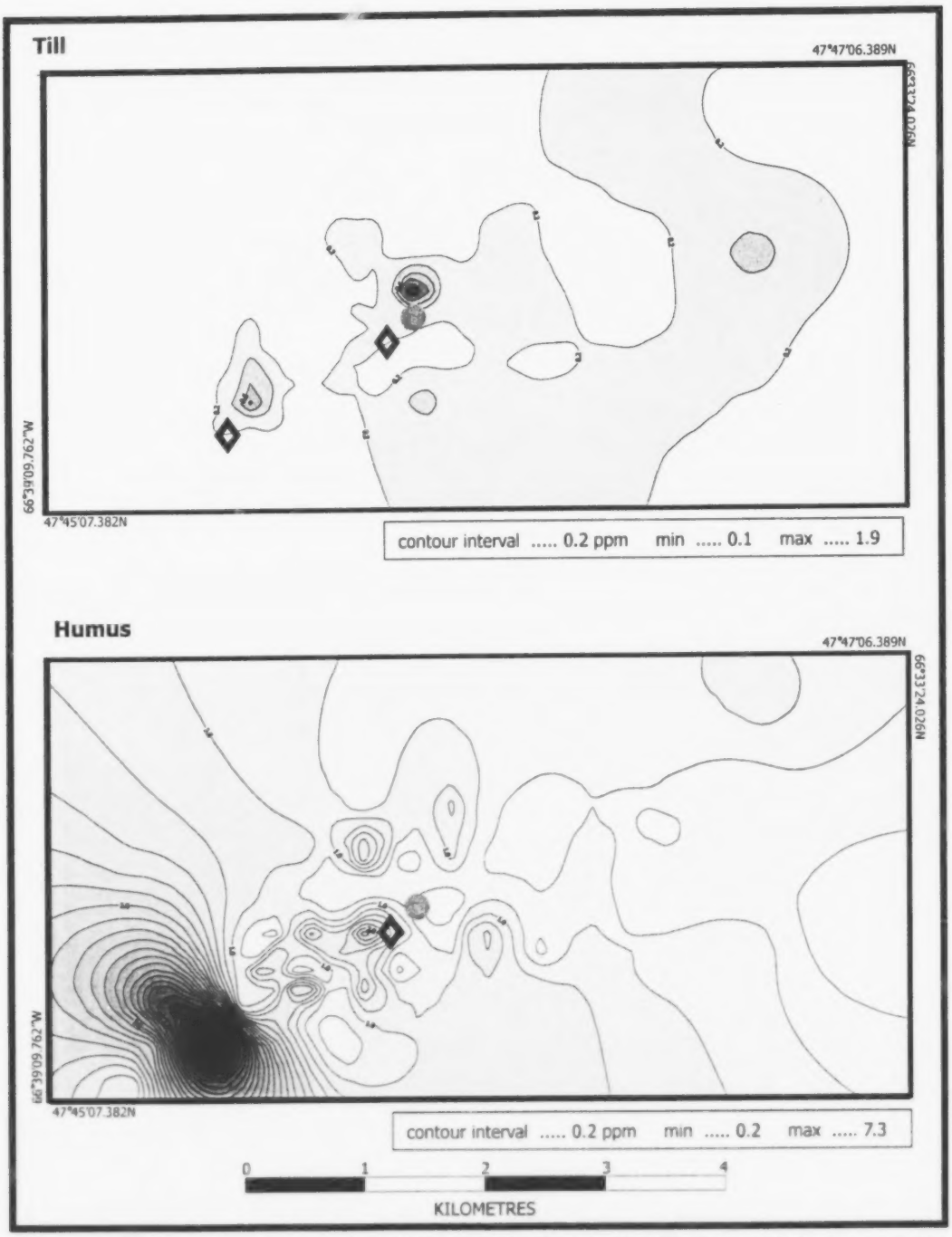



Figure 4.26: Comparison of cadmium (Cd) concentrations in the till matrix with humus samples collected at the same site. Diamond and circle shapes indicate the Popelogan mineral occurrences (from Figure 3.2). Area of study is outlined in Figure 2.1 and 2.2.

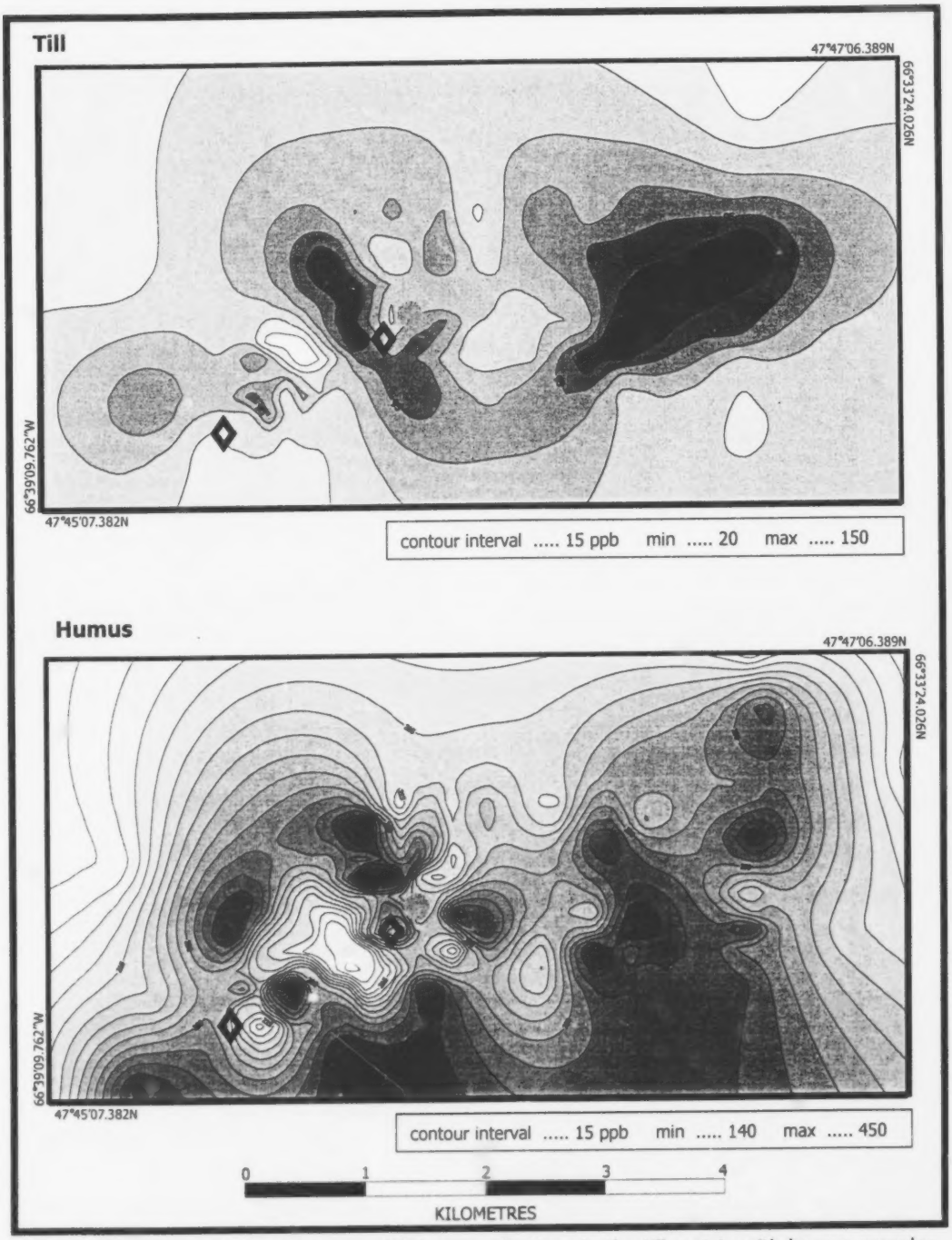



Figure 4.27: Comparison of mercury (Hg) concentrations in the till matrix with humus samples collected at the same site. Diamond and circle shapes indicate the Popelogan mineral occurrences (from Figure 3.2). Area of study is outlined in Figure 2.1 and 2.2.

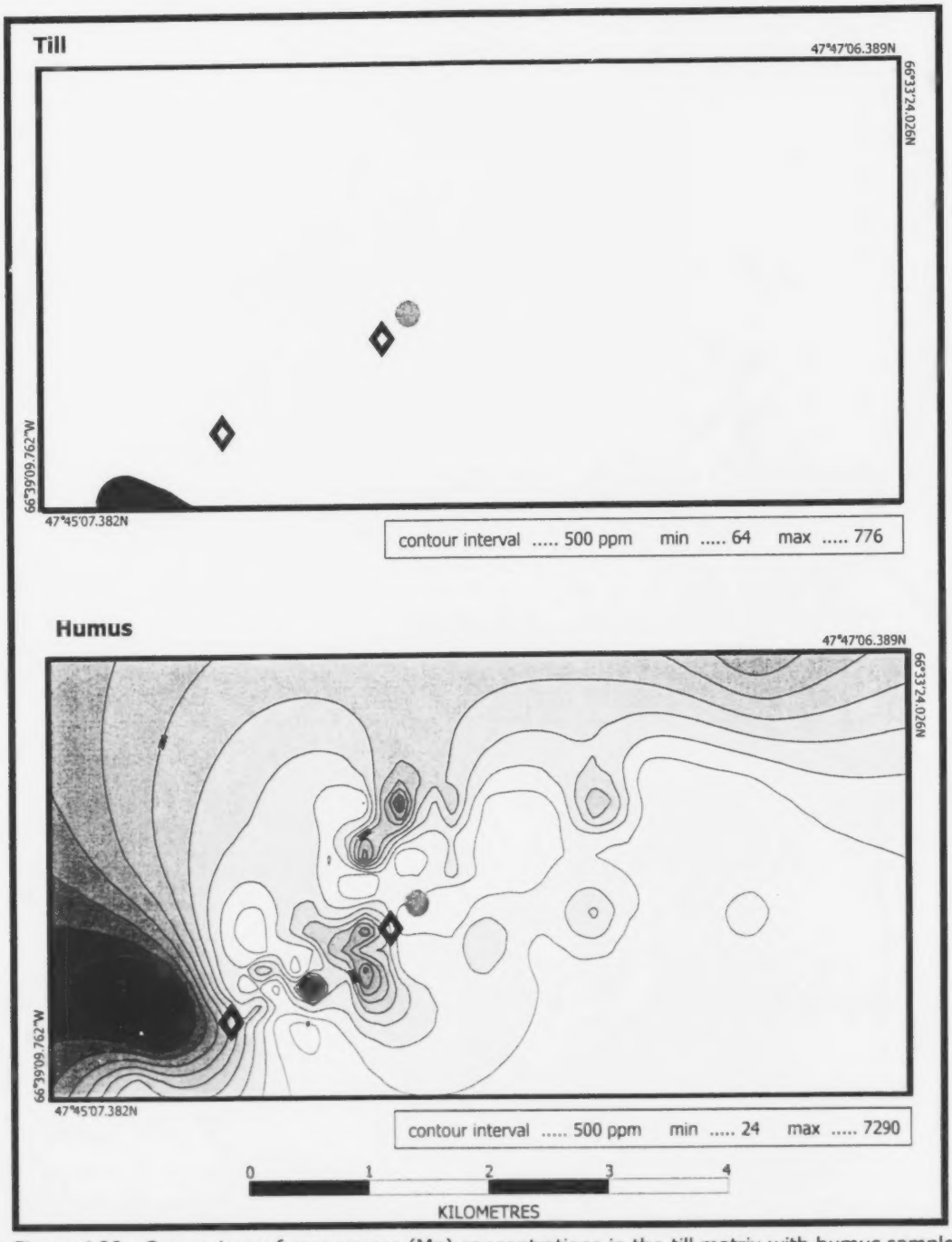



Figure 4.28: Comparison of manganese (Mn) concentrations in the till matrix with humus samples collected at the same site. Diamond and circle shapes indicate the Popelogan mineral occurrences (from Figure 3.2). Area of study is outlined in Figure 2.1 and 2.2.

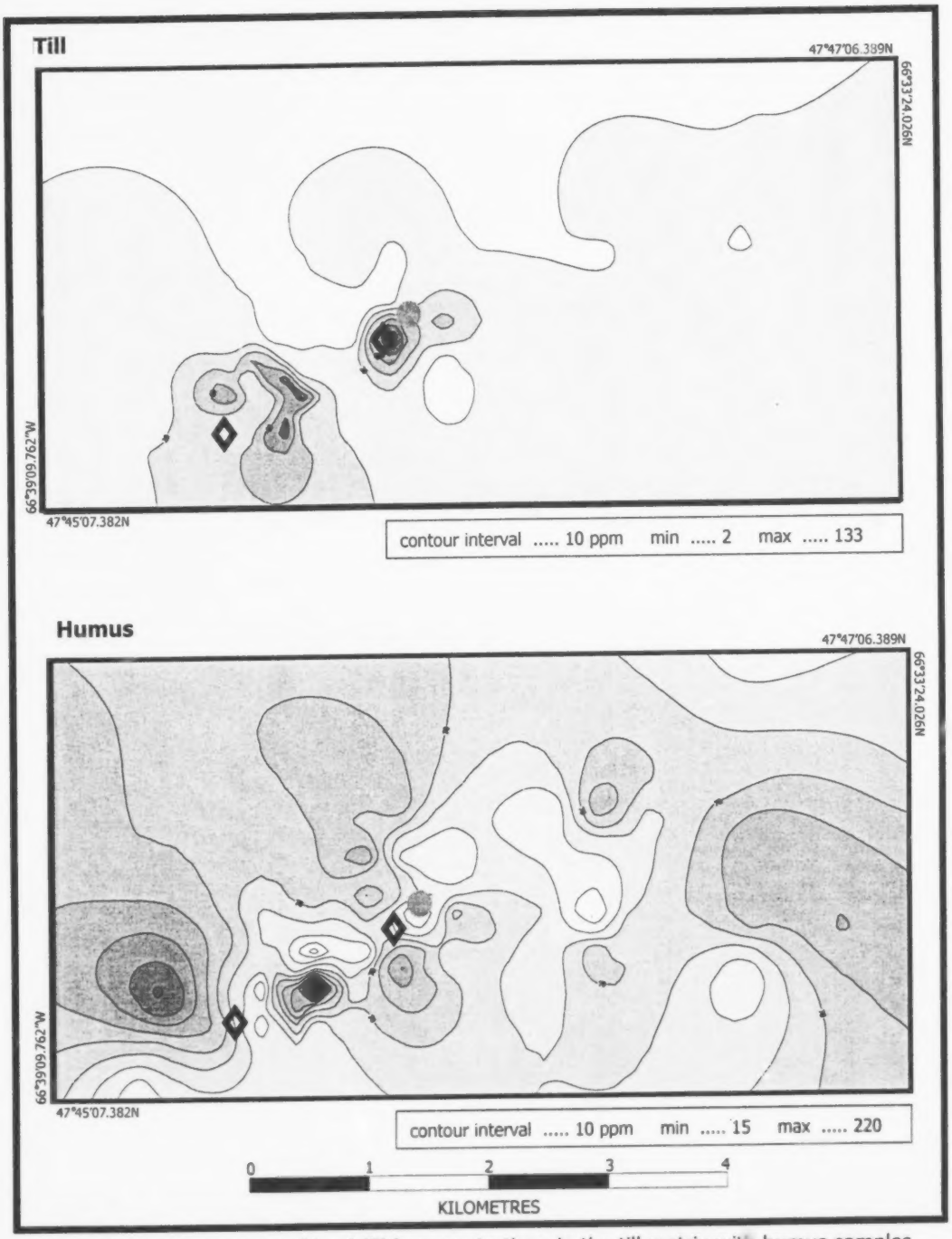



Figure 4.29: Comparison of lead (Pb) concentrations in the till matrix with humus samples collected at the same site. Diamond and circle shapes indicate the Popelogan mineral occurrences (from Figure 3.2). Area of study is outlined in Figure 2.1 and 2.2.

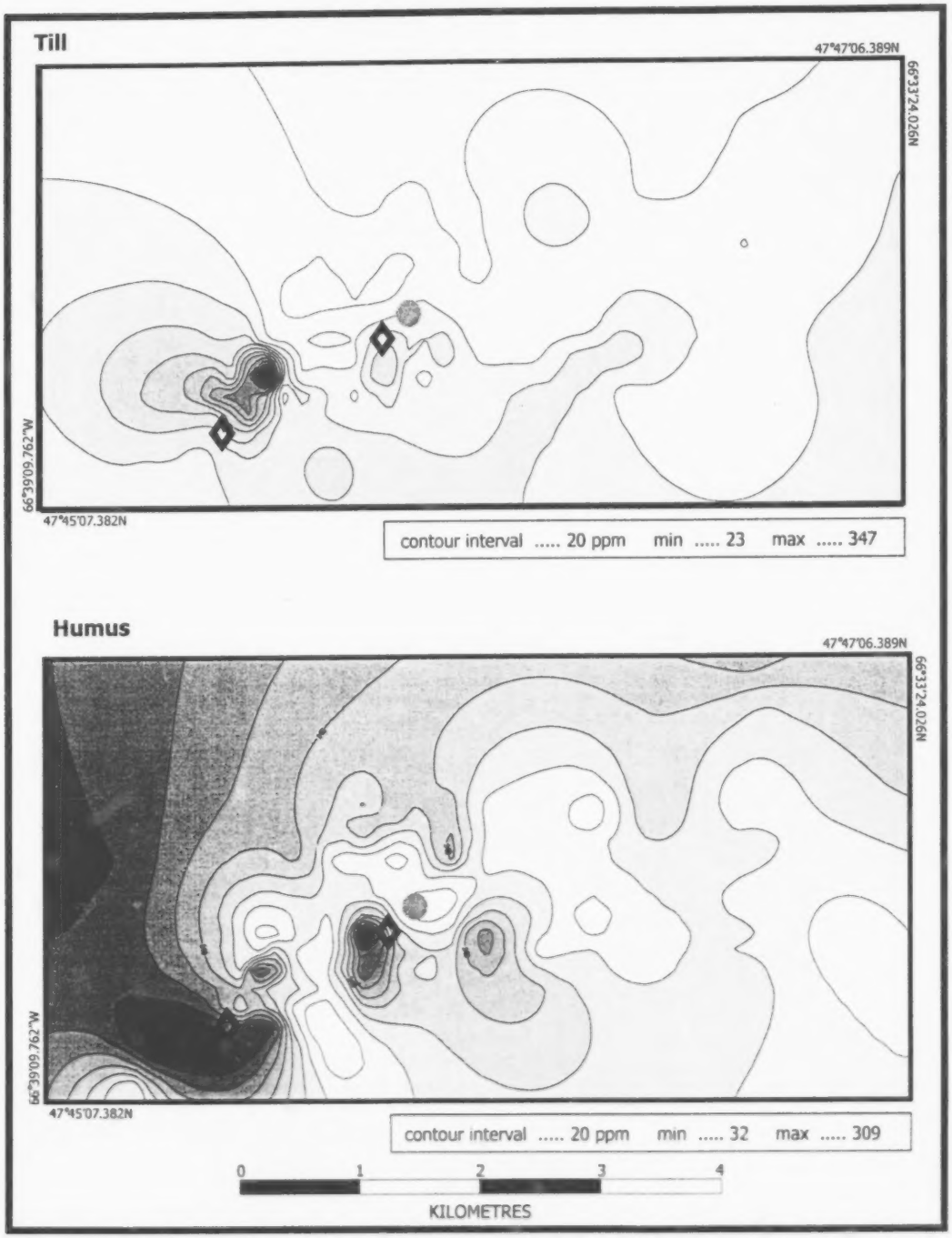



Figure 4.30: Comparison of zinc (Zn) concentrations in the till matrix with humus samples collected at the same site. Diamond and circle shapes indicate the Popelogan mineral occurrences (from Figure 3.2). Area of study is outlined in Figure 2.1 and 2.2.

Table 4.3: Spearman's Rank Correlation Coefficients for Till Geochemical Data (n=312)

| | Ag | As | Au | Ba | Br | Cd | Ce | Co | Cr | Cs | Cu | Eu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ag | 1.000 | | | | | | | | | | | |
| As | 0.227 | 1.000 | | | | | | | | | | |
| Au | - | 0.163 | 1.000 | | | | | | | | | |
| Ba | - | 0.256 | 0.192 | 1.000 | | | | | | | | |
| Br | 0.429 | - | - | -0.315 | 1.000 | | | | | | | |
| Cd | 0.305 | - | - | - | 0.374 | 1.000 | | | | | | |
| Ce | -0.290 | - | - | 0.168 | -0.360 | -0.194 | 1.000 | | | | | |
| Co | -0.244 | 0.193 | - | 0.317 | -0.407 | -0.234 | 0.271 | 1.000 | | | | |
| Cr | - | 0.527 | - | 0.285 | - | - | -0.148 | 0.246 | 1.000 | | | |
| Cs | - | 0.389 | - | 0.235 | - | - | - | 0.422 | 0.379 | 1.000 | | |
| Cu | 0.275 | 0.352 | - | 0.302 | 0.300 | 0.211 | -0.175 | 0.193 | 0.360 | 0.198 | 1.000 | |
| Eu | - | - | - | - | - | - | 0.265 | - | - | - | - | 1.000 |
| Fe | 0.174 | 0.297 | - | - | 0.349 | - | -0.215 | 0.308 | 0.362 | 0.564 | 0.446 | - |
| Hf | - | -0.232 | - | - | -0.270 | - | 0.325 | -0.237 | -0.245 | -0.502 | -0.358 | - |
| Hg | 0.334 | 0.157 | - | - | 0.699 | 0.361 | -0.253 | -0.253 | - | - | 0.343 | - |
| La | -0.248 | - | - | 0.276 | -0.409 | - | - | 0.162 | - | - | - | 0.326 |
| Lu | 0.230 | 0.159 | - | -0.171 | 0.337 | 0.244 | - | -0.212 | - | - | - | - |
| Mn | -0.197 | 0.194 | - | 0.160 | -0.407 | - | 0.378 | 0.628 | - | 0.274 | - | 0.189 |
| Mo | 0.173 | - | - | - | 0.292 | 0.161 | -0.258 | - | - | - | 0.462 | - |
| Na | -0.155 | - | - | 0.266 | -0.323 | - | 0.304 | - | - | - | -0.184 | - |
| Ni | - | 0.519 | - | 0.279 | - | - | - | 0.457 | 0.780 | 0.598 | 0.526 | - |
| Pb | 0.233 | 0.671 | 0.170 | 0.237 | - | 0.291 | - | 0.162 | 0.419 | 0.245 | 0.365 | - |
| Rb | -0.339 | - | 0.172 | 0.489 | -0.433 | -0.224 | 0.245 | 0.394 | 0.178 | 0.549 | - | - |
| Sc | -0.200 | 0.220 | - | 0.276 | -0.182 | -0.182 | 0.309 | 0.588 | 0.248 | 0.543 | 0.330 | 0.244 |
| Sm | -0.160 | - | - | 0.206 | - | - | 0.652 | 0.149 | - | - | - | 0.455 |
| Sn | - | - | - | - | - | - | - | - | - | - | - | - |
| Ta | -0.300 | -0.334 | - | - | -0.409 | - | 0.375 | - | -0.351 | -0.212 | -0.409 | - |
| Tb | - | - | - | - | -0.151 | - | 0.463 | 0.159 | - | - | - | 0.383 |
| Th | -0.216 | - | 0.171 | 0.245 | -0.227 | - | 0.561 | - | - | - | - | 0.209 |
| U | - | - | - | 0.197 | - | - | 0.247 | -0.239 | - | -0.231 | - | 0.163 |
| V | 0.219 | 0.264 | - | - | 0.390 | - | - | 0.213 | 0.189 | 0.225 | 0.563 | - |
| W | 0.186 | - | - | 0.203 | 0.282 | 0.240 | -0.214 | - | - | - | 0.557 | - |
| Yb | -0.185 | -0.150 | - | -0.153 | -0.198 | -0.152 | 0.490 | - | -0.304 | - | -0.471 | 0.179 |
| Zn | 0.181 | 0.473 | - | - | - | 0.168 | - | 0.179 | 0.416 | 0.385 | 0.238 | - |
| Zr | -0.210 | -0.196 | - | - | -0.250 | - | 0.369 | - | -0.274 | -0.324 | -0.288 | - |

* Note: only values significant at the 99.9% confidence interval are shown

Table 4.3 (cont'd): Spearman's Rank Correlation Coefficients for Till Geochemical Data (n=312)

| | Fe | Hf | Hg | La | Lu | Mn | Mo | Na | Ni | Pb | Rb | Sc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ag | | | | | | | | | | | | |
| As | | | | | | | | | | | | |
| Au | | | | | | | | | | | | |
| Ba | | | | | | | | | | | | |
| Br | | | | | | | | | | | | |
| Cd | | | | | | | | | | | | |
| Ce | | | | | | | | | | | | |
| Co | | | | | | | | | | | | |
| Cr | | | | | | | | | | | | |
| Cs | | | | | | | | | | | | |
| Cu | | | | | | | | | | | | |
| Eu | | | | | | | | | | | | |
| Fe | 1.000 | | | | | | | | | | | |
| Hf | -0.780 | 1.000 | | | | | | | | | | |
| Hg | 0.415 | -0.381 | 1.000 | | | | | | | | | |
| La | -0.295 | 0.389 | -0.288 | 1.000 | | | | | | | | |
| Lu | - | - | 0.211 | - | 1.000 | | | | | | | |
| Mn | 0.186 | -0.171 | -0.200 | 0.229 | -0.156 | 1.000 | | | | | | |
| Mo | 0.210 | -0.232 | 0.292 | - | - | - | 1.000 | | | | | |
| Na | -0.705 | 0.686 | -0.421 | 0.431 | - | - | - | 1.000 | | | | |
| Ni | 0.605 | -0.543 | - | - | - | 0.209 | - | -0.380 | 1.000 | | | |
| Pb | 0.241 | -0.210 | 0.168 | - | - | 0.215 | - | - | 0.428 | 1.000 | | |
| Rb | 0.124 | - | -0.321 | 0.257 | - | 0.242 | - | - | 0.299 | - | 1.000 | |
| Sc | 0.389 | -0.339 | - | 0.283 | - | 0.491 | - | - | 0.448 | 0.146 | 0.279 | 1.000 |
| Sm | -0.167 | 0.286 | -0.157 | 0.829 | 0.171 | 0.279 | - | 0.273 | - | - | - | 0.384 |
| Sn | - | - | - | - | - | - | - | - | - | - | - | - |
| Ta | 0.532 | 0.580 | -0.438 | 0.353 | -0.210 | - | -0.217 | 0.430 | -0.453 | -0.234 | 0.197 | - |
| Tb | - | - | - | 0.542 | 0.166 | 0.245 | - | 0.143 | - | 0.151 | - | 0.342 |
| Th | -0.199 | 0.242 | - | 0.534 | - | - | - | 0.222 | - | 0.220 | 0.279 | 0.273 |
| U | -0.396 | 0.512 | - | 0.467 | 0.261 | -0.198 | - | 0.408 | -0.286 | - | - | - |
| V | 0.476 | -0.357 | 0.347 | -0.162 | - | - | 0.283 | -0.190 | 0.292 | 0.182 | -0.176 | 0.487 |
| W | 0.084 | - | 0.286 | - | - | -0.269 | 0.403 | - | - | - | - | - |
| Yb | -0.232 | 0.366 | -0.162 | 0.445 | 0.342 | 0.234 | -0.310 | 0.223 | -0.373 | - | - | - |
| Zn | 0.498 | -0.383 | 0.242 | - | - | 0.282 | - | -0.472 | 0.496 | 0.557 | 0.162 | 0.180 |
| Zr | -0.531 | 0.568 | -0.261 | 0.358 | - | - | - | 0.535 | -0.421 | - | - | -0.147 |

* Note: only values significant at the 99.9% confidence interval are shown

Table 4.3 (ct'd): Spearman's Rank Correlation Coefficients for Till Geochemical Data (n=312)

| | Sm | Sn | Ta | Tb | Th | U | V | W | Yb | Zn | Zr |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ag | | | | | | | | | | | |
| As | | | | | | | | | | | |
| Au | | | | | | | | | | | |
| Ba | | | | | | | | | | | |
| Br | | | | | | | | | | | |
| Cd | | | | | | | | | | | |
| Ce | | | | | | | | | | | |
| Co | | | | | | | | | | | |
| Cr | | | | | | | | | | | |
| Cs | | | | | | | | | | | |
| Cu | | | | | | | | | | | |
| Eu | | | | | | | | | | | |
| Fe | | | | | | | | | | | |
| Hf | | | | | | | | | | | |
| Hg | | | | | | | | | | | |
| La | | | | | | | | | | | |
| Lu | | | | | | | | | | | |
| Mn | | | | | | | | | | | |
| Mo | | | | | | | | | | | |
| Na | | | | | | | | | | | |
| Ni | | | | | | | | | | | |
| Pb | | | | | | | | | | | |
| Rb | | | | | | | | | | | |
| Sc | | | | | | | | | | | |
| Sm | 1.000 | | | | | | | | | | |
| Sn | - | 1.000 | | | | | | | | | |
| Ta | 0.238 | - | 1.000 | | | | | | | | |
| Tb | 0.703 | - | - | 1.000 | | | | | | | |
| Th | 0.517 | - | 0.287 | 0.373 | 1.000 | | | | | | |
| U | 0.460 | - | 0.288 | 0.349 | 0.479 | 1.000 | | | | | |
| V | - | - | -0.336 | - | - | - | 1.000 | | | | |
| W | - | - | -0.147 | - | - | 0.210 | 0.266 | 1.000 | | | |
| Yb | 0.413 | - | 0.315 | 0.352 | 0.185 | 0.219 | -0.233 | - | 1.000 | | |
| Zn | - | - | -0.287 | - | - | -0.195 | - | - | - | 1.000 | |
| Zr | 0.306 | - | 0.408 | 0.253 | 0.319 | 0.379 | -0.225 | - | 0.342 | -0.276 | 1.000 |

* Note: only values significant at the 99.9% confidence interval are shown

between different lithological groups.

The correlation between humus and till was calculated for the following elements: Ag, As, Au, Cd, Cu, Mo, Mn, Pb, W, and Zn. Most of the elements showed weak correlations (Table 4.4), with the exception of As (r=0.60), Mo (r=0.61), and W (r=0.63).

Table 4.4: Spearman's Rank Correlation Coefficients for Till and Humus Data (n = 109)

| | | Till | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ag | As | Au | Cd | Cu | Mn | Mo | Pb | W | Zn |
| Humus | Ag | 0.541 | - | - | - | - | - | - | - | - | - |
| | As | - | 0.602 | - | - | - | - | - | - | - | - |
| | Au | - | - | 0.495 | - | - | - | - | - | - | - |
| | Cd | - | - | - | 0.471 | | - | - | - | - | - |
| | Cu | - | - | - | - | 0.571 | - | - | - | - | - |
| | Mn | - | - | - | - | - | 0.495 | - | - | - | - |
| | Mo | - | - | - | - | - | - | 0.611 | - | - | - |
| | Pb | - | - | - | - | - | - | - | 0.395 | - | - |
| | W | - | - | - | - | - | - | - | - | 0.634 | - |
| | Zn | - | - | - | - | - | - | - | - | - | 0.545 |

**Table 4.4: Spearman's Rank Correlation Coefficients for Till and Humus Data (n = 109)**

| | | Till | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ag | As | Au | Cd | Cu | Mn | Mo | Pb | W | Zn |
| Humus | Ag | 0.541 | - | - | - | - | - | - | - | - | - |
| | As | - | 0.602 | - | - | - | - | - | - | - | - |
| | Au | - | - | 0.495 | - | - | - | - | - | - | - |
| | Cd | - | - | - | 0.471 | | - | - | - | - | - |
| | Cu | - | - | - | - | 0.571 | - | - | - | - | - |
| | Mn | - | - | - | - | - | 0.495 | - | - | - | - |
| | Mo | - | - | - | - | - | - | 0.611 | - | - | - |
| | Pb | - | - | - | - | - | - | - | 0.395 | - | - |
| | W | - | - | - | - | - | - | - | - | 0.634 | - |
| | Zn | - | - | - | - | - | - | - | - | - | 0.545 |

# CHAPTER 5

# DISCUSSION

## 5.1 Mineral Exploration Using Glacigenic Sediments

Exploration in areas of glaciated terrain presents some difficulties for prospectors, as glacial sediments of varying composition and thickness can conceal potential mineral resources. Traditional methods of bedrock mapping and geophysics may not reveal the desired information. However, drift prospecting can provide an inexpensive, yet effective means of delineating subsurface mineral potential (Shilts, 1984; Broster and Huntley, 1995).

A successful exploration program in glaciated terrain begins with a sound understanding of the principles of drift prospecting and the glacial history of the area. The glacial history and ice-flow dynamics of an area are reflected in the provenance and composition of its glacial sediments. Thus, proper identification of glacial sediments defines the mode of entrainment of debris and the direction and distance of glacial transport and, therefore, is the key to tracing geochemically anomalous overburden back to its bedrock source (Coker, 1991; Klassen, 1997).

Glacial drift is an extremely variable medium, consisting of a number of sedimentary facies deposited in a variety of glacial environments. Despite their variability, glacigenic sediments are, in their simplest forms, derivatives of bedrock (Shilts, 1976, 1991) and weathered equivalents. Shilts (1976) subdivided glacigenic sediments into first, second, and third derivatives, depending on the processes by which they were transported and deposited. Till is considered a first derivative sediment, as its components are derived from the bedrock surface through subglacial abrasion and erosion and deposited directly beneath the ice. Therefore, till composition, matrix geochemistry, till fabric, and clast lithologies will reflect the former ice-flow directions of an area (Shilts, 1976, 1991).

Second derivative sediments are those derived from glaciofluvial processes. Subglacial and proglacial meltwaters erode and sort the sediment, redistributing the fine-grained particles

throughout the glaciofluvial system (Shilts, 1991). These sediments may otherwise have been deposited as till; however, due to fluvial action they have undergone additional phases of transport and are deposited as eskers, kames, and proglacial outwash (Shilts, 1976).

Post-glacial lacustrine, marine, and modern fluvial sediments, composed of the fine-grained materials removed from previously deposited glacial sediments are referred to as third derivative sediments (Shilts, 1976, 1991). These sediments undergo several phases of transport before settling out of suspension some distance from the original bedrock source.

Fluvial mixing and sorting combines sediments from a large region, resulting in second and third derivative sediments with compositions that are difficult to trace back to an original bedrock source. Till, however, has a distinct composition reflecting the bedrock lithologies of the local area. Consequently, mineral exploration using first derivative sediment - till - will be significantly more successful than with second or third derivative sediments.

## 5.2 Till Content

Once the sedimentological nature of a glacigenic sediment has been determined, it is essential to examine the stratigraphy, and the effects of chemical partitioning and post-glacial weathering on the sediment before conclusions can be made about the provenance of the sediment.

### 5.2.1 Texture and Stratigraphy

In areas with complex ice-flow histories, multiple till units may be deposited as a result of changes in modes of entrainment, transport, comminution, and direction of ice-flow during subsequent readvances. These stratigraphically different units can be recognized by the textural differences resulting from these changes (Fenton and Dreimanis, 1976). In drift prospecting investigations it is necessary to distinguish between stratigraphically different units at each sample location and to correlate these with other locations to prevent distortion of dispersal data.

### 5.2.2 Bimodal Distribution

The texture of a till is determined by the proportions of its lithic components. Glacial transport of debris results in two grain-size modes, clast-sized (> 2.5 cm) and matrix-sized (< 2 mm). This bimodal distribution depends on several factors, including distance from the source and the resistance of the source rock to comminution (Dreimanis and Vagners, 1969, 1971). As new debris is incorporated into the glacial sediment load the clast-sized mode increases. However, with further transport these clasts are comminuted to the finer matrix-sized mode. Generally, the clast-sized mode indicates a proximal bedrock source, whereas the matrix fraction reflects more distal sources (Dreimanis and Vagners, 1969, 1971).

### 5.2.3 Terminal Grades and Partitioning

Glacial comminution reduces minerals to a characteristic fine-grained mode. These 'terminal grades' are the smallest particle sizes to which the minerals can be reduced and depend on the original size of the minerals and their resistance to abrasion (Dreimanis and Vagners, 1969, 1971). Therefore, the sand fraction of the till matrix will be dominated by harder minerals such as quartz, whereas the fine fraction (silt+clay) is dominated by soft minerals such as micas (Dreimanis and Vagners, 1969, 1971; Shilts, 1991). The terminal grade of a mineral strongly reflects its chemical composition; hence, mineralogical partitioning within the till matrix can be expected to translate into a chemical partitioning.

Understanding the partitioning of glacial sediments requires recognition of how metals are distributed within the matrix and which size fraction will provide accurate geochemical information on provenance (Coker and DiLabio, 1987; Shilts, 1991). Lithophile elements, associated with more resistant K-feldspar, tend to concentrate in the coarse-grained fraction. Phyllosilicate and secondary minerals dominate the fine (clay) fraction and, therefore, due to their greater ability to adsorb cations, tend to be enriched in the more labile chalcophile (base-metal) elements (Shilts, 1976, 1984, 1991; Coker and DiLabio, 1987).

As a consequence of this enrichment of metallic elements, analysis of samples with differing clay contents may yield different geochemical signatures.

Post-glacial weathering of labile trace metals results in the destruction of the primary mineral phases, reducing them to clay-sized particles and redistributing them into secondary phases (Shilts, 1991). Therefore, within the oxidized zone (the upper 2m of till) there is a significant decrease of metal concentrations within the coarse-grained (sand) fraction and a similar increase of some metals in the fine-grained fraction. Understanding this vertical variation in weathering effects is paramount when evaluating the geochemical signature of the silt+clay fraction of till (Shilts, 1991).

## 5.3. Dispersal Patterns

Debris entrained by a glacier is dispersed down-ice from its source, producing a ribbon-shaped or fan-shaped dispersal train, a body of sediment enriched in trace elements or clasts from a specific bedrock source relative to the surrounding sediment (Coker and DiLabio, 1987; DiLabio, 1990; Figure 5.1). Shilts (1976) has shown that idealized dispersal trains take the form of negative exponential curves (Figure 5.2). Peak concentrations occur at the 'head' of the train near the source and rapidly decline down-ice to background concentrations in the 'tail' (Shilts, 1976). Dispersal trains can range from a few metres to hundreds of kilometres. More significantly, dispersal trains tend to be much larger than the actual source and therefore, anomalous content is much easier to recognize during exploration (Shilts, 1976; Coker and DiLabio, 1987; DiLabio, 1990; Parent et al., 1996).

The size and shape of a dispersal train depend upon: 1) the size and erodibilty of the source, as well as its orientation relative to ice-flow direction; 2) the topography of the dispersal area; and 3) the type of till being sampled. A source which is composed of 'soft' (low strength) bedrock or is highly fractured will provide a relatively large amount of debris compared to a hard, massive outcrop. Depressions aligned parallel to ice-flow tend to increase ice velocity through the area and produce greater amounts of debris than in flat terrain (Shilts, 1991). In areas of variable relief, valleys,

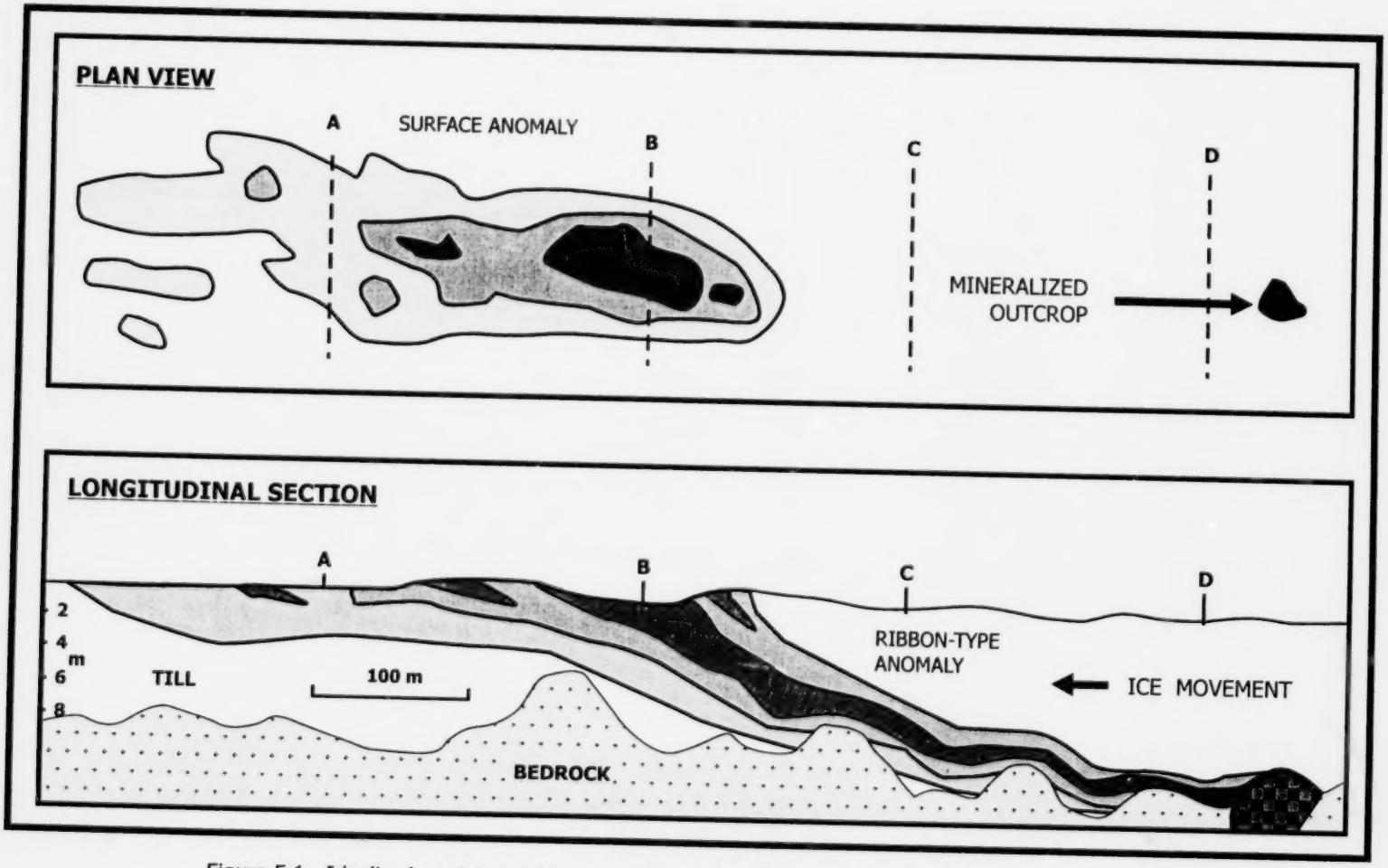



Figure 5.1: Idealized model of a dispersal train, after (Miller, 1984 and DiLabio, 1990).

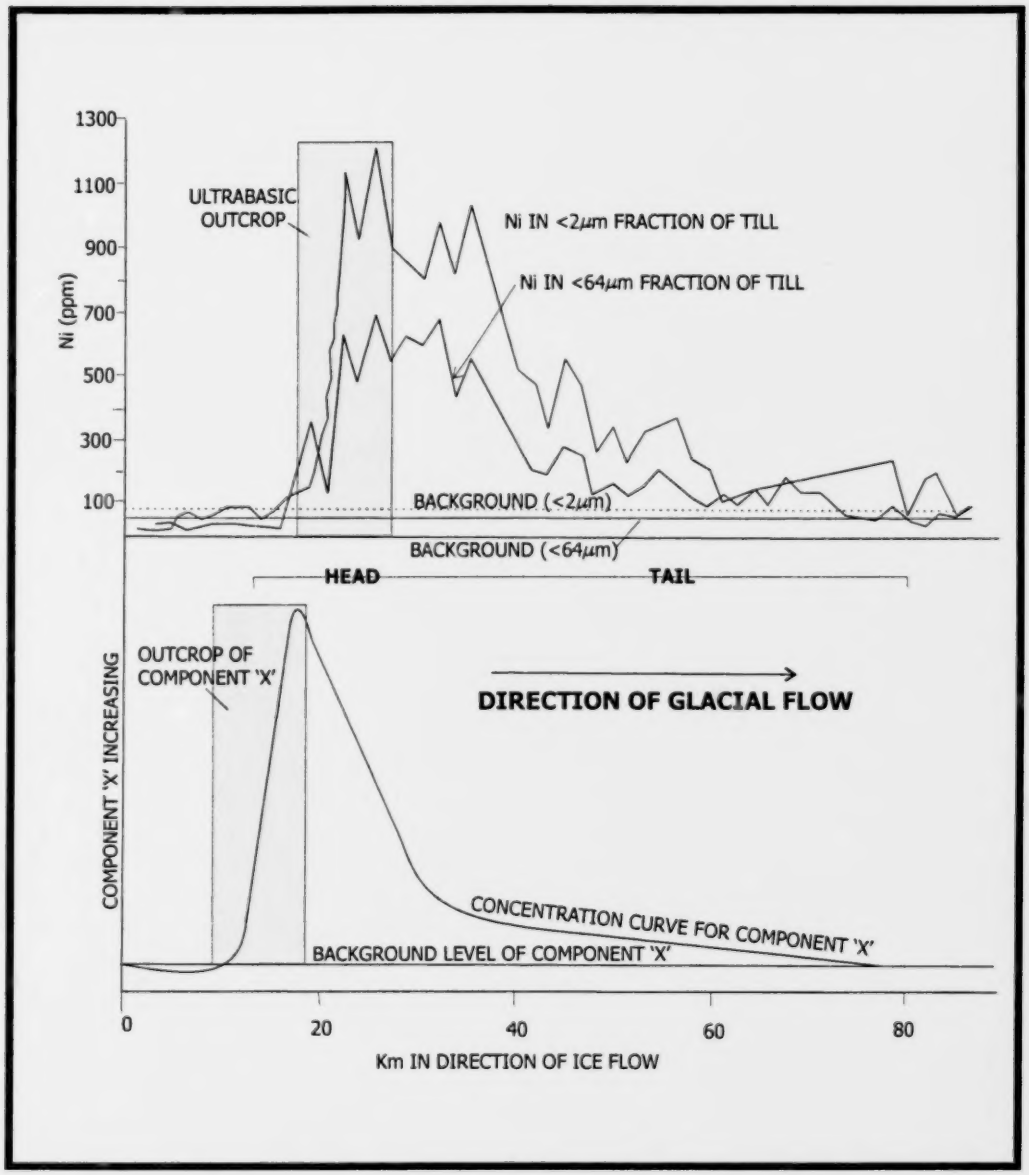



Figure 5.2: Dispersal curves for distinct components within till. Actual Ni data (top) from the Thetford Mines area, Quebec. Idealized curve (bottom) shows the negative exponential curve (after Shilts, 1976); DiLabio, 1990).

ridges, and escarpments may divert or block ice-flow, therefore displacing, truncating, or destroying dispersal patterns (Coker and DiLabio, 1987; DiLabio, 1990; Shilts, 1991). Ablation till (sensu stricto; Dreimanis, 1976) and basal till (sensu stricto; Dreimanis, 1976) will reflect different elements of the dispersal area. Basal till will generally contain debris from lower elevations and more local sources, while ablation till reflects higher elevations or more distal sources (Shilts, 1991).

In areas of multiple ice-flow directions the classical fan-shaped dispersal train (Shilts, 1976) actually represents the combination of trains from each flow event. The composite train consists of a main dispersal train in the latest direction of flow and a palimpsest dispersal train (Parent et al., 1996) produced during an earlier event in a different direction and remobilized during subsequent ice movement (Figure 5.3). Generally, debris concentrations within a palimpsest train are about half of those in the main train (Parent et al., 1996). Recognition of these palimpsest dispersal trains is important when assessing dispersal patterns during drift prospecting studies.

### 5.3.1 Clast Dispersal

Clast dispersal patterns in the study area are small, ranging in length from a few hundred metres to several kilometres (8 km maximum). The absence of any clast lithologies foreign to the study area indicates that clast content is locally derived. Clast concentrations are highest near bedrock sources, decreasing rapidly down-ice and across bedrock contacts (Figures 4.10, 4.11, 4.13, 4.14). Patterns are generally irregular or bulls-eye-shaped over source areas.

Multiple ice-flow directions are indicated by clast dispersal patterns in different parts of the study area. In the area of the Popelogan porphyry-skarn occurrences (southwestern part of the study area) mineralized clasts (Figure 4.9) have been transported a short distance eastward from the occurrences, while at the same location hornfels and skarn clasts record northward transport. Granite dispersal patterns in the same area are oriented east-northeast. In general, clast dispersal patterns in the western portion of the study area is dominantly oriented eastward, whereas patterns in the eastern part of the study area are oriented towards the north-northeast.

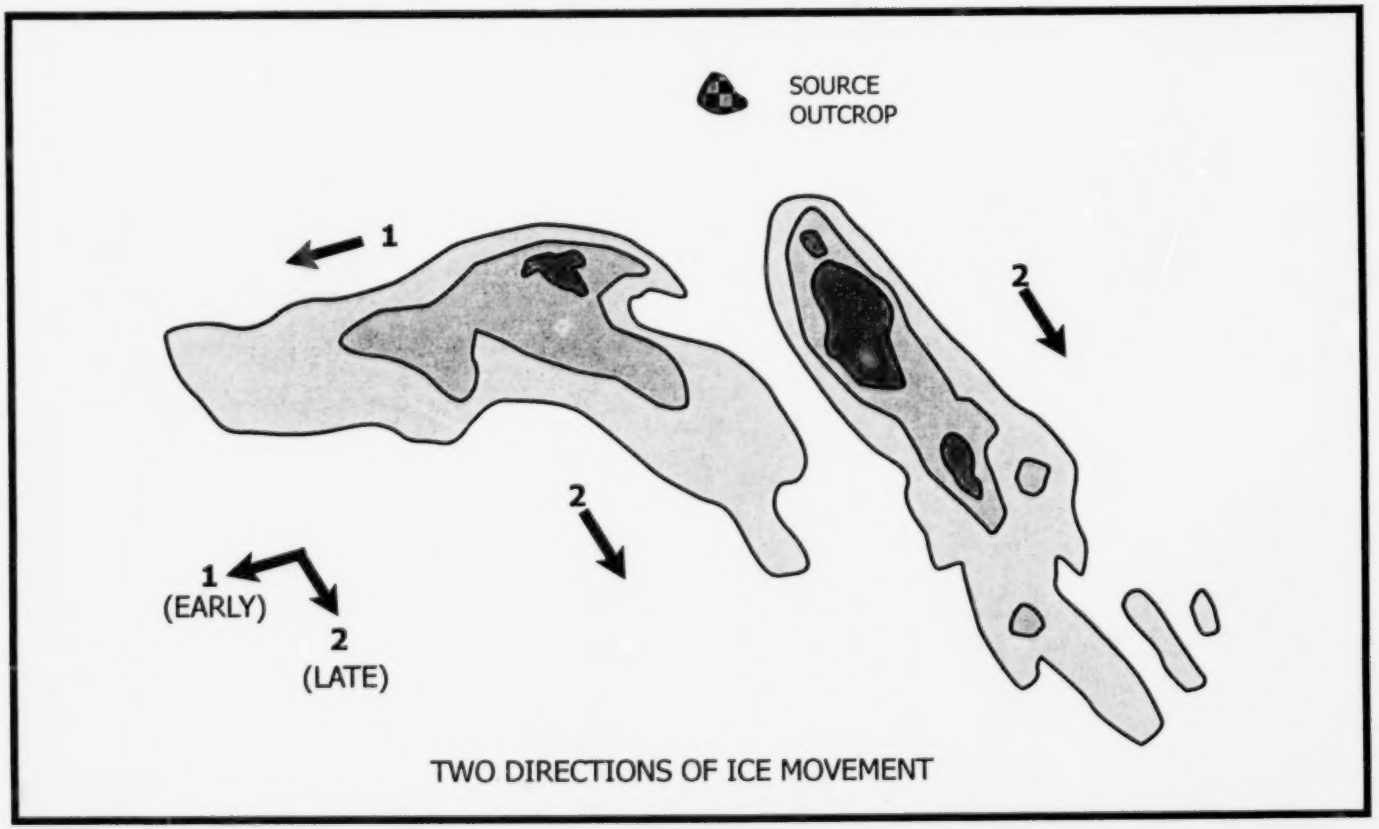



Figure 5.3: Main, ribbon-shaped, dispersal train and palimpsest dispersal train resulting from successive ice-flow events.

Significant clast dispersal patterns of rhyolite are observed in the southeast corner of the study area, over Blue Mountain. Clast concentrations as high as 100% extend 8 km north from Blue Mountain (< 600 m a.s.l.). It is likely that as ice moved across the study area, it preferentially eroded the rhyolite at Blue Mountain due to the higher elevation of this point. This preferential erosion manifests itself in longer dispersal patterns than for material entrained at lower elevations (cf. Hornibrook et al., 1993).

In comparison to clast dispersal pattern from other lithological groups, dispersal patterns of gabbro clasts in the southern part of the study area do not originate over known bedrock sources and therefore may indicate an unknown gabbro source in the area. A large point source (38%) in the northeast corner may be the result of erosion and incorporation of volcanic boulder conglomerate of the New Mills Formation (Figure 3.2).

### 5.3.2 Grain Size Concentrations

The granulometric portion of the tills in the study area is dominated by sand (27 - 83%) with a slightly lesser amount of silt (12 - 63%) and a minor amount of clay (8 - 35%). The dominant sand and silt granulometric texture of the till is expected from glacial erosion of an area dominated by igneous and clastic sedimentary lithologies (cf. Dreimanis and Vagners, 1971). Large transport distances (10 - 100s of kilometres) are required to comminute most rock types to clay-size grains (cf. Dreimanis and Vagners, 1971), but dispersal patterns for clast and geochemical data (below) in the study area suggest derivation of local material and relatively short (<10 km) transport. Therefore, clay content in the till is likely due to incorporation of pre-glacial sediment, especially near the coast and along valleys.

### 5.3.3 Geochemical Dispersal

Detailed sampling (50 - 100m spacing) in the area of the Popelogan skarn occurrences helped detect the head of dispersal trains originating from the occurrences. Anomalous

concentrations of Ag (> 0.9 ppm), Cu (> 600 ppm), Mo (55 ppm), Pb (> 100 ppm), W (67 ppm), and Zn (> 300 ppm) occur in till overlying the Popelogan porphyry-skarn occurrences (Figures 4.18, 4.20, 4.21, 4.22, 4.23, 4.24). These concentrations generally form bulls-eye patterns directly above the occurrences with some elongation (< 2 km) to the east-northeast. These geochemical dispersal patterns indicate a very localized source for till components and that anomalous values in till occur less than 1 km down-ice from their original source. These patterns can be used to locate other possible zones of mineralization in the study area:

(1) Coincident dispersal patterns of Ag ( 0.6 ppm), Cu (120 ppm), Mo (12 ppm), and W (2 ppm) along the northern contact of the Popelogan intrusion (Figures 4.18, 4.20, 4.21, 4.23).

(2) Concentrations of Pb (>40 ppm) and Zn (>140 ppm) form coincident dispersal patterns, elongated east-northeast from the northwestern edge of the study area (Figures 4.22, 4.24).

(3) As (26 ppm), Cu (145 ppm), Mo (12 ppm), W (5 ppm), and Zn (106 ppm) form coincident dispersal patterns associated with a felsic intrusion and an eastward trending fault (Figures 4.18, 4.20, 4.21, 4.23, 4.24).

### 5.3.4 Humus

Humus samples exhibit higher mean concentrations for Ag, Cd, Hg, Mn, Pb, and Zn, than those found contained in the till matrix. These concentrations are likely the result of the ability of humus to adsorb cations and form complexes with these metals, relative to the ability of the clay size-fraction in the till matrix (cf. Fitzpatrick, 1986). Plants require elements for survival, including minor amounts of Cu, Zn, Fe, Mo, Mn, and B (Rose et al., 1979). These elements are taken up from the C-horizon through the roots and concentrated on the plant tissues. As the plant vegetation decays rain water leaches out the more soluble elements, which are then removed by surface and

groundwater or reprecipitated in the B-horizon. The less soluble elements remain in the humus layer and accumulated over time, thus enriching the humus layer.

The study area is well-vegetated with many deep-rooting trees and shrubs which take up the chemical elements of the soil and near-surface water. The humus resulting from the decay of this vegetation thus reflects the geochemical signature of the underlying material from which it originally grew. As such, humus samples can reflect underlying sources of element concentration, and their content of some elements can be enriched relative to the buried source material. Humus can be considered a second or even third derivative sediment (cf. Shilts, 1976); thus, while geochemical sampling of humus can expose anomalous areal concentrations of some elements, the geochemical concentration patterns do not necessarily form elongated or wedge-shaped dispersal patterns that can be traced back to their exact source. In this study, none of the higher elemental concentrations were correlative with the highest value in till or underlying bedrock source.

As humus has the ability to concentrate elements from the underlying substrate (till), it can be a suitable sample medium when conducting reconnaissance surveys to delineate areas for further exploration. Because it is a third derivative sediment it does not directly reflect the underlying bedrock, nor does it give any indication as to ice-flow direction and, as such, it should only be used as a preliminary stage preceding till clast and geochemical sampling in drift exploration studies.

## 5.4 Erosional Indicators

Striae and streamlined landforms measured in the study area demonstrate three main ice-flow directions. Cross-cutting striae (Figure 4.5) indicate an early movement to the southeast (160°), followed by movement to the east (110°), and finally by movement to the northeast (010°). The earliest movement to the southeast (110° to 168°) is rarely preserved and is only recorded at a few sites (Table 4.1). This glacial flow direction probably represents weak glacial abrasion and erosion resulting from the initial advance of local Appalachian ice (Pronk et al., 1989).

The major eastward flow is likely correlative to the Jacquet and Baie des Chaleurs flow patterns of Rampton et al. (1984). This flow direction previously has been reported to occur as the dominant direction of flow through the area by Chalmers (1886, 1887), Gauthier (1982), Rampton et al. (1984), Pronk (1986, 1987), Bobrowsky et al. (1987), Lamothe (1992), Pronk and Parkhill (1988), and Pronk et al. (1989).

A third ice-flow direction recognized in the study area is flow to the north-northeast (010° to 060°). Striae indicating glacial movement in this direction are found predominantly in the northeastern part of the study area (Figure 4.4). This flow event likely represents a shift in the eastward flow due to drawdown in the Baie des Chaleurs (Pronk et al., 1989).

Clast, granulometric, and geochemical dispersal patterns of the till in the study area support the major east and north-northeastward ice-flow directions recorded by the striae. In the southeast corner of the study area eastward-trending striae are dominant, in contrast with northward-oriented clast dispersal trains recorded in the same area. These data suggest that eastward-moving ice eroded and transported material, but that deposition likely occurred under the influence of north-northeastward-moving ice. This is supported by the northeastward orientated geochemical dispersal patterns (Figures 4.18 - 4.24) in the same area. This evidence suggests that in areas of multiple ice-flow events: (1) indicators of glacial erosion (striae and streamlined landforms) can be biased towards earlier, highly erosive events and (2) till clast and geochemical dispersal patterns can be more useful than striae for defining exploration targets.

# CHAPTER 6

# CONCLUSIONS

The main conclusions arising from the examination of glacigenic sediments and landforms in the Atholville and Charlo map areas of northeastern New Brunswick are:

**(1).** Striae and streamlined landforms demonstrate three main ice-flow events, in chronological order: (1) southeast; (2) east; and (3) north-northeast.

**(2).** The earliest southeastward flow represents regional growth and expansion of ice caps from the west. Eastward flow was the dominant flow pattern, while north-northeastward flow represents a shift in eastward flow as a result of drawdown in the Baie des Chaleurs.

**(3).** A single basal till was recognized in the study area. Variations in texture and granulometric composition reflect underlying bedrock units.

**(4).** Glaciomarine clays along the shores of the Baie des Chaleurs and in the banks of the banks of the Charlo River Valley indicate a marine incursion during deglaciation.

**(5).** Glaciofluvial ice-contact deltaic sediments indicate that the marine incursion reached an elevation of at least 100m.

**(6).** Clast and geochemical dispersal patterns suggest till deposition from eastward and north-northeastward-moving ice.

**(7).** Dispersal patterns indicate transport distances of less than 10 km for till clasts and less than 2 km for till matrix elemental dispersal.

**(8).** Known mineral occurrences are reflected as anomalous point source geochemical dispersal patterns in till overlying the occurrences.

**(9).** Humus is enriched in some elements through biogeochemical processes and hydromorphic dispersion and, thus can define large areal dispersal patterns. As such, humus can be an effective sampling medium during reconnaissance survey to delineate areas for further exploration using till clast dispersal and geochemistry.

**(10).** Examination of clast and geochemical dispersal from the Popelogan skarn occurrences indicates that other anomalous concentrations in the study area, not related to any known mineralization, represent local up-glacier sources of unknown mineralization.

**(11).** Detailed sampling (50 - 100 m spacing) is required to delineate dispersal patterns in the area, due to the short distance of glacial transport.

# REFERENCES


AGRICULTURE CANADA EXPERT COMMITTEE ON SOIL SURVEY 1987. The Canadian System of Soil Classification. 2nd ed. Agriculture Canada Publication, 1646, 164 p.

BOSTOCK, H. S. 1970. Physiographic Subdivisions of Canada; *In* Geology and Economic Minerals of Canada. *Edited by* R. J. W. Douglas. Geological Survey of Canada, Economic Geology Report 1, 10-30.

BOUYOUCOS, G. J. 1962. Hydrometer Methods Improved for Making Particle Size Analysis of Soils. Agronomy Journal, 54, 464-465.

BOBROWSKY, P. T., LAMOTHE, M., AND SHILTS, W. W. 1987. Late Quaternary Glaciation and Deglaciation in the Baie des Chaleurs Area, Northern New Brunswick. Geological Association of Canada/Mineralogical Association of Canada, Program with Abstracts, p. 26.

BRINSMEAD, R. A. 1979a. Granular Aggregate Resources, Charlo Map Area, 21 O/16. New Brunswick Department of Natural Resources, Mineral Resources Branch, Open File Report 79-10, 79 p.

BROSTER, B. E. 1982. Compositional Variations in the St. Joseph Till Units of the Goderich Area, Ontario. PhD Thesis, University of Western Ontario, London, Ontario, 103 p.

BROSTER, B. E. AND CLAGUE, J. J. 1987. Advance and Retreat Glacigenic Deformation at Williams Lake, British Columbia. Canadian Journal of Earth Sciences, 24, 1421-1430.

BROSTER, B. E. AND HUNTLEY, D. H. 1995. Effective Low -Cost Reconnaissance Drift Prospecting in Areas of Variable Terrain: An Example From the South-East Taseko Lakes Area, Central British Columbia. *In* Drift Exploration in the Canadian Cordillera. *Edited by* Bobrowsky, P. T., Sibbick, S. J., Newell, J. H., and Matysek, P. F. British Columbia Ministry of Energy, Mines and Petroleum Resources, Paper 1995-2, 121-126.

---------- 1979b. Granular Aggregate Resources, Upsalquitch Forks Map Area (21 O/10) and part of Nepisiguit Lakes (21 O/7) Map-Areas. New Brunswick Department of Natural Resources, Mineral Resources Branch, Open File Report 79-11, 53 p.

CHALMERS, R. C. 1885. Preliminary Report on the Surface Geology of New Brunswick. Geological and Natural History Survey of Canada, Annual Report, vol. I, 58 p.

---------- 1886. Surface Geology of Northern New Brunswick and South-Eastern Quebec. Geological and Natural History Survey of Canada, Annual Report, vol. II, Part M, 39 p.

---------- 1887. Surface Geology of North-Eastern New Brunswick. Geological and Natural History Survey of Canada, Annual Report, vol. III, Part N, 33 p.

---------- 1898. The Pre-Glacial Decay of Rocks in Eastern Canada. American Journal of Science, 155, 273-282.

COKER, W.B. 1991. Overburden Geochemistry in Mineral Exploration. *In* Exploration Geochemistry Workshop. Geological Survey of Canada, Open File 2390, 3-1 to 3-60.

COKER, W. B. AND DiLABIO, R. N. W. 1987. Geochemical Exploration in Glaciated Terrain: Geochemical Responses. *In* Proceedings of Exploration '87. *Edited by* G. D. Garland. Third Decennial International Conference on Geochemical Exploration for Minerals and Groundwater. Ontario Geological Survey, Special Volume 3, 336-383.

DiLABIO, R.N.W. 1990. Glacial Dispersal Trains. *In* Glacial Indicator Tracing. *Edited by* R. Kujansuu and M. Saarnisto. Balkema, Rotterdam, 109-122..

DREIMANIS, A. 1976. Tills: Their Origin and Properties. *In* Glacial Till: An Interdisciplinary Study. *Edited by* R.F. Legget. Royal Society of Canada Special Publication 12, 11-49.

DREIMANIS, A. AND VAGNERS, U.J. 1969. Lithologic Relation of Till to Bedrock. *In* Quaternary Geology and Climate. *Edited by* H.E. Wright Jr. Vol. 16 of the Proceedings of the VII Congress of the International Association for Quaternary Research. National Academy of Science, Washington, 93-98.

---------- 1971. Bimodal Distribution of Rock and Mineral Fragments in Basal Till. *In* Glacial Till: An Interdisciplinary Study. *Edited by* R.F. Legget. Royal Society of Canada Special Publication 12, 237-250.

FENTON, M. M. AND DREIMANIS, A. 1976. Methods of Stratigraphic Correlation of Till in Central and Western Canada. *In* Glacial Till: An Interdisciplinary Study. *Edited by* R.F. Legget. Royal Society of Canada Special Publication 12, 67-82.

FINAMORE, P. F. 1979a. Granular Aggregate Resources of the Campbellton and Escuminac Map Areas, New Brunswick (N.T.S. 21 O/15 and 22 B/1). New Brunswick Department of Natural Resources, Mineral Resources Branch, Open File Report 79-12, 93 p.

---------- 1979b. Granular Aggregate Resources of the Tetagouche Lakes Map-Area, New Brunswick (N.T.S 21 O/9). New Brunswick Department of Natural Resources, Mineral Resources Branch, Open File Report 79-13, 28 p.

FITZPATRICK, E. A. 1986. An Introduction to Soil Science - Second Edition. John Wiley & Sons, Inc., New York, 110-111.

FLETCHER, W. K. 1981. Analyticai Methods in Geochemical Prospecting - Volume 1. *In* Handbook of Exploration Geochemistry. *Edited by* G. J. S. Govett. Elsevier Scientific Publishing Company

FYFFE, L. R. AND FRICKER, A. 1987. Tectonostratigraphic Terrane Analysis of New Brunswick. Maritime Sediments and Atlantic Geology, 23, 113-123.

GAUTHIER, R. C. 1978. Intensity and extent of the Last Glaciation in the Maritimes. Geological Association of Canada, Abstract with Programs, 3, 406.

---------- 1982. Quaternary Geology of Northern New Brunswick. Geological Survey of Canada, unpublished manuscript.

---------- 1983. Surficial Deposits, Northern New Brunswick. Geological Survey of Canada, Open File Report 856, 9 maps.

HALL, G. E. M. 1991. Analytical Methods Used in Exploration Geochemistry. *In* Exploration Geochemistry Workshop. Geological Survey of Canada, Open File 2390, 8-1 to 8-90.

HORNIBROOK, E. R. C., BROSTER, B. E., GARDINER, W. W., AND PRONK, A. G. 1993. Glacial Dispersal of Garnets and Other Heavy Minerals in Till: Miramichi Area, New Brunswick. Exploration Mining Geology, 2, 345-353.

IRRINKI, R. R. 1990. Geology of the Charlo area; Restigouche County, New Brunswick. New Brunswick Department of Natural Resources and Energy, Mineral Resources, Report of Investigation 24, 118 p.

KLASSEN, R. A. 1997. Glacial History and Ice Flow Dynamics Applied to Drift Prospecting and Geochemical Exploration. *In* Proceedings of Exploration 97: Fourth Decennial International Conference on Mineral Exploration, GEO F/X, 221-232.

LAMOTHE, M. 1986. Reconnaissance Geochemical Sampling of Till, South-Central Miramichi Zone, New Brunswick. *In* Current Research, Part B, Geological Survey of Canada, Paper 86-1B: p. 279-287.

---------- 1992. Pleistocene Stratigraphy and Till Geochemistry of the Miramichi Zone, New Brunswick. Geological Survey of Canada, Bulletin 433, 58 p.

LANGTON, J. P. 1999. Preliminary Geology of the South Charlo River Area (NTS 21 O/16d), Restigouche County, New Brunswick. New Brunswick Department of Natural Resources and Energy, Minerals and Energy Division, (no plate #).

---------- 2000. Preliminary Geology of the Balmoral Area (NTS 21 O/16e), Restigouche County, New Brunswick. New Brunswick Department of Natural Resources and Energy, Minerals and Energy Division, (no plate #).

MATTHEW, G. F. 1872. On the Suface Geology of New Brunswick. Canadian Naturalist, New Series: VI, 107 p.

---------- 1879. Report on the Superficial Geology of Southern New Brunswick. Geological Survey of Canada, Report of Progress 1877-1878, Part X, 36 p.

McGREW, J. C. AND MONROE, C. B. 1993. An Introduction to Statistical Problem Solving in Geography. W. M. Brown Publishers, Dubuque, IA, USA, p. 243-264.

MILLER, J. K. 1984. Model for Clastic Indicator Trains in Till. *In* Prospecting in Areas of Glaciated Terrain-1984. Institute of Mining and Metallurgy, London, 69-77.

PARENT, M., PARADIS, S. J., AND DOIRON, A. 1996. Palimpsest Glacial Dispersal Trains and their Significance for Drift Exploration. Journal of Geochemical Exploration, 56, 123-140.

PRONK, A. G. 1986. Till Geochemistry of the Tetagouche Lakes Area (21 O/9) New Brunswick. New Brunswick Department of Forest, Mines, and Energy, Mineral Resources Division, Geological Notes Series, PM 86-216, 10 p.

---------- 1987. Surficial Geology and Till Geochemistry of the Upsalquitch Forks (21 O/10) Map Area (with emphasis on gold distribution in tills). New Brunswick Department of Natural Resources and Energy, Mineral Resources Division, Geological Notes Series 87-47, 8 p.

PRONK, A. G. AND PARKHILL, M. A. 1988. Surficial Geology and Till Geochemistry (Au, As, Sb, Hg, Bi, Cu, Pb, Zn, Ag, Mn, Fe, Co, Ni, Mo) of the Atholville (21 O/15) Map Area and Part of Escuminac (22 B/1) and Oak Bay (22 B/2) Map Areas, New Brunswick. New Brunswick Department of Natural Resources and Energy, Mineral Resources Division, Geological Notes Series PM 88-10, 7 p.

PRONK, A. G., BOBROWSKY, P. T., AND PARKHILL, M. A. 1989. An Interpretation of Late Quaternary Glacial Flow Indicators in the Baie Des Chaleurs Region, Northern New Brunswick. Geographie Physique et Quaternaire, vol. 43, no. 2, 179-190.

QUARTERMAIN, R. A. 1981. Popelogan Lake, New Brunswick, Property Appraisal and Proposal for Further Work. Unpublished M.Sc. Thesis, Queens University, Kingston, Ontario, 79 p.

RAMPTON, V. N., GAUTHIER, R.C., THIBAULT, J., AND SEAMAN, A. A. 1984. Quaternary Geology of New Brunswick. New Brunswick Department of Natural Resources, Minerals Development Branch, Map Report 81-3, 36 p.

ROSE, D.G. and JOHNSON, S.C. 1990. New Brunswick Computerized Mineral Occurrence Database. New Brunswick Department of Natural Resources and Energy, Minerals and Energy Division, Mineral Resource Report 3, 69 p.

RUITENBERG, A. A., FYFFE, L. R., MCCUTCHEON, S. R., ST. PETER, C. J., IRRINKI, R. R., AND VENUGOPAL, D. V. 1977. Evolution of Pre-Carboniferous Tectonostratigraphic Zones in the New Brunswick Appalachians. Geoscience Canada, 4, 171-181.

SHILTS, W. W. 1976. Glacial Till and Mineral Exploration. *In* Glacial Till, An Interdisciplinary Study. *Edited by* R. F. Legget. Royal Society of Canada Special Publications, 12, 205-223.

---------- 1984. Till Geochemistry in Finland and Canada. Journal of Geochemical Exploration, 21, 95-117.

---------- 1991. Principles of Glacial Dispersal and Sedimentation. *In* Exploration Geochemistry Workshop. Geological Survey of Canada, Open File 2390, 2-1 to 2-42.

---------- 1993. Geological Survey of Canada's Contribution to the Understanding of Composition of Glacial Sediments. Canadian Journal of Earth Sciences, 30, 333-353.

SILK, J. 1979. Statistical Concepts in Geography. George Allen and Unwin, London, 276 p.

VAN STAAL, C. R. AND FYFFE, L. R. 1995. Dunnage Zone - New Brunswick. *In* Chapter 3 of Geology of the Appalachian-Caledonian Orogen in Canada and Greenland. *Edited by* H. Williams. Geological Survey of Canada, Geology of Canada, No. 6, 166-178.

VEILLETTE, J. J. AND NIXON, F. M. 1982. Saprolite in the Big Bald Mountain Area, New Brunswick. *In* Current Research, Part B, Geological Survey of Canada, Paper 82-1B, 63-70.

WILLIAMS, H. 1979. Appalachian Orogen in Canada. Canadian Journal of Earth Sciences, 792-807.

WILSON, R. A. 2000a. Preliminary Geology of the Popelogan Lake Area (NTS 21 O/15a), Restigouche County, New Brunswick. New Brunswick Department of Natural Resources and Energy, Minerals and Energy Division, Plate 2000-25.

---------- 2000b. Preliminary Geology of the Lost Pine Lake Area (NTS 21 O/15b), Restigouche County, New Brunswick. New Brunswick Department of Natural Resources and Energy, Minerals and Energy Division, Plate 2000-26.

WILSON, R. A., LANGTON, J. P., AND CARROLL, J. I. 2000. Geological Bridges of Eastern Canada NATMAP Project: bedrock mapping in Restigouche County, New Brunswick. *In* Atlantic Geoscience Society Colloquium and Annual General Meeting: Current Research in the Atlantic Provinces, Programs and Abstract, p. 46.

WOODS, G. A. 1993 Skarn Type Base Metal Deposits in the McKenzie Gulch, Patapedia, and Popelogan Areas. *In* Guidebook to the Porphyry Copper and Copper Skarn Mineralization in Northern New Brunswick and Gaspé, Quebec. *Edited by* S. R. McCutcheon and G. A. Woods, Trip #1 of Bathurst '93: 3rd Annual Field Conference, Geological Society of CIM, 42-53.

ZELAZNY, V. F., NG, T. T. M., HAYTER, M. G., BOWLING, C. L., AND BEWICK, D. A. 1989. Field Guide to Forest Site Classification in New Brunswick, Upsalquitch Site Region, New Brunswick Department of Natural Resources and Energy, 43 p.

# APPENDIX I

## SAMPLE SITE LOCATIONS

A total of 328 samples were examined in this study. One hundred and fifty-seven samples were obtained from archival data, while the remaining 171 were collected during the 1998 and 1999 field seasons. Geographical co-ordinates were measured in CARIS® using the NAD 83 ellipsoid for latitude and longitude and the ATS77 Ellipsoid for X/Y coordinates. The Projection for ATS77 is the New Brunswick stereographic projection (ST), which has a false northing (Y) of 800,000 and a false easting (X) of 300,000. There is no associated datum for NB Stereographic; the X/Y coordinates relate to the false northing and easting values. On this imaginary X/Y grid, NB is in the positive X, positive Y quadrant. The imaginary origin (0,0) is located in southern Maine.

Each sample was labelled using an eight to ten character code ( i.e. MP990001), indicating the collector, the year the sample was collected, and the sample number. The following is a list of letter-number codes indicating the person(s) who obtained the sample and the year:

**TP85** - A. G. Pronk (1985)

**TP87** - A. G. Pronk and M. Parkhill (1987)

**87LFA** - M. Lamothe (1987)

**ML98** - ML. Dickson and M. Parkhill (1998)

**MP99** - ML. Dickson and M. Parkhill (1999)

The study area incorporates portions of four NTS map sheets indicated by:

**21 O/9** - Tetagouche Lakes

**21 O/10** - Upsalquitch Forks

**21 O/15** - Atholville

**21 O/16** - Charlo

## APPENDIX I: Sample Site Locations

| Sample Number | Map Sheet | X (mE) | Y (mN) | Lat. (N) | Long. (W) |
|---|---|---|---|---|---|
| TP850001 | 21O/9 | 300957 | 938101 | 47-44-31.806 | 66-29-14.061 |
| TP850015 | 21O/9 | 302936 | 938127 | 47-44-32.630 | 66-27-39.074 |
| TP850029 | 21O/9 | 304953 | 938119 | 47-44-32.322 | 66-26-02.268 |
| TP850043 | 21O/9 | 306935 | 938125 | 47-44-32.450 | 66-24-27.122 |
| TP850057 | 21O/9 | 308932 | 938156 | 47-44-33.350 | 66-22-51.312 |
| TP850071 | 21O/9 | 311000 | 938136 | 47-44-32.594 | 66-21-12.031 |
| TP850085 | 21O/9 | 313038 | 938151 | 47-44-32.949 | 66-19-34.231 |
| TP850099 | 21O/9 | 314988 | 938186 | 47-44-33.931 | 66-18-00.624 |
| TP850113 | 21O/9 | 317008 | 938186 | 47-44-33.743 | 66-16-23.667 |
| TP870150 | 21O/15 | 285143 | 948257 | 47-49-59.971 | 66-41-54.326 |
| TP870151 | 21O/15 | 285122 | 946224 | 47-48-54.162 | 66-41-55.072 |
| TP870152 | 21O/15 | 285115 | 944211 | 47-47-48.989 | 66-41-55.163 |
| TP870153 | 21O/15 | 285138 | 942248 | 47-46-45.438 | 66-41-53.836 |
| TP870154 | 21O/15 | 285107 | 940236 | 47-45-40.319 | 66-41-55.077 |
| TP870164 | 21O/15 | 287175 | 948252 | 47-49-59.975 | 66-40-16.615 |
| TP870165 | 21O/15 | 287150 | 946249 | 47-48-55.144 | 66-40-17.592 |
| TP870166 | 21O/15 | 287149 | 944209 | 47-47-49.091 | 66-40-17.469 |
| TP870167 | 21O/15 | 287160 | 942282 | 47-46-46.717 | 66-40-16.699 |
| TP870168 | 21O/15 | 287161 | 940224 | 47-45-40.078 | 66-40-16.456 |
| TP870178 | 21O/15 | 289161 | 948294 | 47-50-01.461 | 66-38-41.147 |
| TP870179 | 21O/15 | 289143 | 946268 | 47-48-55.877 | 66-38-41.806 |
| TP870180 | 21O/15 | 289174 | 944245 | 47-47-50.376 | 66-38-40.153 |
| TP870181 | 21O/15 | 289185 | 942211 | 47-46-44.537 | 66-38-39.428 |
| TP870182 | 21O/15 | 289160 | 940246 | 47-45-40.905 | 66-38-40.478 |
| TP870192 | 21O/15 | 291172 | 948242 | 47-49-59.886 | 66-37-04.470 |
| TP870193 | 21O/15 | 291148 | 946237 | 47-48-54.990 | 66-37-05.468 |
| TP870194 | 21O/15 | 291161 | 944250 | 47-47-50.640 | 66-37-04.710 |
| TP870195 | 21O/15 | 291208 | 942214 | 47-46-44.733 | 66-37-02.292 |
| TP870196 | 21O/15 | 291162 | 940199 | 47-45-39.503 | 66-37-04.359 |
| TP870206 | 21O/15 | 293153 | 948274 | 47-50-01.007 | 66-35-29.209 |
| TP870207 | 21O/15 | 293153 | 946262 | 47-48-55.861 | 66-35-29.098 |
| TP870208 | 21O/15 | 293196 | 944220 | 47-47-49.764 | 66-35-26.915 |
| TP870209 | 21O/15 | 293148 | 942138 | 47-46-42.367 | 66-35-29.117 |
| TP870210 | 21O/15 | 293135 | 940218 | 47-45-40.214 | 66-35-29.634 |
| TP870220 | 21O/15 | 295180 | 948241 | 47-50-00.018 | 66-33-51.736 |
| TP870221 | 21O/15 | 295168 | 946207 | 47-48-54.172 | 66-33-52.221 |
| TP870222 | 21O/15 | 295161 | 944204 | 47-47-49.326 | 66-33-52.513 |
| TP870223 | 21O/15 | 295150 | 942134 | 47-46-42.312 | 66-33-52.954 |
| TP870224 | 21O/15 | 295157 | 940198 | 47-45-39.621 | 66-33-52.519 |
| TP870234 | 21O/15 | 297218 | 948180 | 47-49-58.089 | 66-32-13.780 |
| TP870235 | 21O/15 | 297180 | 946206 | 47-48-54.182 | 66-32-15.554 |
| TP870236 | 21O/15 | 297176 | 944235 | 47-47-50.369 | 66-32-15.686 |
| TP870237 | 21O/15 | 297152 | 942099 | 47-46-41.199 | 66-32-16.792 |
| TP870238 | 21O/15 | 297167 | 940206 | 47-45-39.926 | 66-32-16.034 |

## APPENDIX I: Sample Site Locations

| Sample Number | Map Sheet | X (mE) | Y (mN) | Lat. (N) | Long. (W) |
|---|---|---|---|---|---|
| TP870248 | 21O/15 | 299196 | 948181 | 47-49-58.142 | 66-30-38.665 |
| TP870249 | 21O/15 | 299175 | 946232 | 47-48-55.028 | 66-30-39.664 |
| TP870250 | 21O/15 | 299252 | 944192 | 47-47-48.993 | 66-30-35.945 |
| TP870251 | 21O/15 | 299138 | 942208 | 47-46-44.745 | 66-30-41.418 |
| TP870252 | 21O/15 | 299172 | 940230 | 47-45-40.731 | 66-30-39.765 |
| 85LFA0513 | 21O/16 | 309867 | 939379 | 47-45-12.911 | 66-22-06.333 |
| 85LFA0514 | 21O/16 | 314057 | 940542 | 47-45-50.292 | 66-18-45.053 |
| 85LFA0515 | 21O/16 | 312497 | 942120 | 47-46-41.471 | 66-19-59.790 |
| 85LFA0518 | 21O/16 | 310692 | 945858 | 47-48-42.616 | 66-21-26.160 |
| 85LFA0550 | 21O/15 | 296104 | 950977 | 47-51-28.611 | 66-33-07.395 |
| 85LFA0551 | 21O/15 | 295934 | 947280 | 47-49-28.927 | 66-33-15.480 |
| 85LFA0555 | 21O/16 | 304617 | 948408 | 47-50-05.426 | 66-26-17.985 |
| 85LFA0556 | 21O/16 | 306303 | 945366 | 47-48-26.884 | 66-24-57.097 |
| 85LFA0557 | 21O/16 | 307816 | 941773 | 47-46-30.504 | 66-23-44.632 |
| 85LFA0559 | 21O/15 | 298604 | 941640 | 47-46-26.382 | 66-31-07.043 |
| 85LFA0560 | 21O/15 | 297306 | 944834 | 47-48-09.768 | 66-32-09.432 |
| 87LFA2000 | 21O/16 | 308111 | 962288 | 47-57-34.616 | 66-23-29.078 |
| 87LFA2001 | 21O/16 | 306459 | 958845 | 47-55-43.239 | 66-24-48.910 |
| 87LFA2002 | 21O/16 | 308646 | 957890 | 47-55-12.217 | 66-23-03.618 |
| 87LFA2004 | 21O/16 | 304534 | 956667 | 47-54-32.791 | 66-26-21.702 |
| 87LFA2005 | 21O/16 | 304166 | 953894 | 47-53-03.036 | 66-26-39.517 |
| 87LFA2006 | 21O/16 | 302821 | 953389 | 47-52-46.721 | 66-27-44.267 |
| 87LFA2007 | 21O/16 | 303284 | 951280 | 47-51-38.429 | 66-27-22.042 |
| 87LFA2008 | 21O/16 | 305456 | 946360 | 47-48-59.091 | 66-25-37.773 |
| 87LFA2009 | 21O/16 | 305569 | 943988 | 47-47-42.294 | 66-25-32.433 |
| 87LFA2010 | 21O/16 | 304802 | 942101 | 47-46-41.248 | 66-26-09.379 |
| 87LFA2011 | 21O/16 | 302060 | 941551 | 47-46-23.471 | 66-28-21.058 |
| 87LFA2012 | 21O/16 | 301521 | 942449 | 47-46-52.547 | 66-28-46.947 |
| 87LFA2013 | 21O/16 | 301017 | 941428 | 47-46-19.519 | 66-29-11.177 |
| 87LFA2014 | 21O/16 | 302739 | 939984 | 47-45-32.735 | 66-27-48.494 |
| 87LFA2015 | 21O/16 | 304084 | 943037 | 47-47-11.560 | 66-26-43.793 |
| 87LFA2016 | 21O/16 | 307047 | 943886 | 47-47-38.945 | 66-24-21.449 |
| 87LFA2017 | 21O/16 | 308208 | 942728 | 47-47-01.400 | 66-23-25.737 |
| 87LFA2018 | 21O/16 | 306987 | 939575 | 47-45-19.396 | 66-24-24.548 |
| 87LFA2019 | 21O/16 | 305033 | 945308 | 47-48-25.047 | 66-25-58.113 |
| 87LFA2020 | 21O/16 | 304089 | 946189 | 47-48-53.594 | 66-26-43.451 |
| 87LFA2021 | 21O/16 | 314855 | 939726 | 47-45-23.803 | 66-18-06.834 |
| 87LFA2022 | 21O/16 | 309472 | 944847 | 47-48-09.950 | 66-22-24.844 |
| 87LFA2024 | 21O/16 | 309512 | 943528 | 47-47-27.246 | 66-22-23.055 |
| 87LFA2025 | 21O/16 | 310717 | 943485 | 47-47-25.786 | 66-21-25.155 |
| 87LFA2026 | 21O/16 | 310862 | 944472 | 47-47-57.726 | 66-21-18.101 |
| 87LFA2027 | 21O/16 | 309057 | 951939 | 47-51-59.550 | 66-22-44.245 |
| 87LFA2028 | 21O/16 | 309246 | 949475 | 47-50-39.787 | 66-22-35.370 |
| 87LFA2029 | 21O/16 | 312842 | 952431 | 47-52-15.272 | 66-19-42.136 |
| 87LFA2030 | 21O/16 | 312293 | 950481 | 47-51-12.171 | 66-20-08.723 |
| 87LFA2031 | 21O/16 | 311112 | 948794 | 47-50-17.642 | 66-21-05.695 |

## APPENDIX I: Sample Site Locations

| Sample Number | Map Sheet | X (mE) | Y (mN) | Lat. (N) | Long. (W) |
|---|---|---|---|---|---|
| 87LFA2032 | 21O/16 | 310287 | 947434 | 47-49-33.660 | 66-21-45.455 |
| 87LFA2033 | 21O/16 | 302068 | 964559 | 47-58-48.315 | 66-28-20.295 |
| 87LFA2034 | 21O/16 | 300327 | 966211 | 47-59-41.821 | 66-29-44.211 |
| 87LFA2035 | 21O/16 | 305541 | 966333 | 47-59-45.686 | 66-25-32.775 |
| 87LFA2101 | 21O/16 | 318066 | 943576 | 47-51-59.550 | 66-22-44.245 |
| 87LFA2107 | 21O/16 | 317320 | 945862 | 47-47-28.157 | 66-15-32.092 |
| 87LFA2135 | 21O/16 | 300436 | 944133 | 47-48-42.216 | 66-16-07.579 |
| 87LFA2136 | 21O/16 | 302574 | 945065 | 47-48-17.244 | 66-27-56.303 |
| 87LFA2137 | 21O/16 | 301457 | 945620 | 47-48-35.206 | 66-28-49.961 |
| 87LFA2138 | 21O/16 | 301587 | 946692 | 47-49-09.924 | 66-28-43.711 |
| 87LFA2139 | 21O/16 | 302697 | 947066 | 47-49-22.030 | 66-27-50.358 |
| 87LFA2143 | 21O/16 | 317140 | 950778 | 47-51-21.397 | 66-16-15.533 |
| 87LFA2144 | 21O/16 | 316386 | 947942 | 47-49-49.652 | 66-16-52.195 |
| 87LFA2145 | 21O/16 | 316309 | 949522 | 47-50-40.820 | 66-16-55.679 |
| 87LFA2146 | 21O/16 | 315889 | 945803 | 47-48-40.447 | 66-17-16.393 |
| 87LFA2201 | 21O/16 | 318634 | 961498 | 47-57-08.720 | 66-15-01.984 |
| 87LFA2202 | 21O/16 | 318068 | 960145 | 47-56-24.546 | 66-15-29.542 |
| 87LFA2205 | 21O/16 | 315586 | 963722 | 47-58-20.558 | 66-17-28.630 |
| 87LFA2206 | 21O/16 | 317125 | 959560 | 47-56-05.676 | 66-16-15.034 |
| 87LFA2207 | 21O/16 | 316033 | 958673 | 47-55-37.060 | 66-17-07.775 |
| 87LFA2208 | 21O/16 | 314109 | 958038 | 47-55-16.664 | 66-18-40.505 |
| 87LFA2237 | 21O/16 | 307064 | 942756 | 47-47-02.355 | 66-24-20.675 |
| 87LFA2238 | 21O/16 | 313560 | 943135 | 47-47-14.259 | 66-19-08.602 |
| 87LFA2242 | 21O/16 | 316787 | 940730 | 47-45-56.139 | 66-16-33.917 |
| 87LFA2243 | 21O/16 | 318372 | 939574 | 47-45-18.566 | 66-15-18.009 |
| 87LFA2244 | 21O/16 | 316616 | 941480 | 47-46-20.433 | 66-16-42.018 |
| 87LFA2245 | 21O/16 | 316375 | 941665 | 47-46-26.441 | 66-16-53.574 |
| 87LFA2246 | 21O/16 | 318292 | 942712 | 47-47-00.139 | 66-15-21.358 |
| 87LFA3001-1 | 21O/16 | 314527 | 965081 | 47-59-04.646 | 66-18-19.543 |
| 87LFA3003-1 | 21O/16 | 303191 | 963495 | 47-58-13.852 | 66-27-26.167 |
| 87LFA3004-1 | 21O/16 | 304792 | 942414 | 47-46-51.366 | 66-26-09.842 |
| 87LFA3005-1 | 21O/16 | 315884 | 952022 | 47-52-01.764 | 66-17-15.805 |
| 87LFA5159 | 21O/16 | 312072 | 959051 | 47-55-49.626 | 66-20-18.523 |
| 87LFA5160 | 21O/16 | 312965 | 960979 | 47-56-51.984 | 66-19-35.299 |
| 87LFA5388 | 21O/16 | 303778 | 949714 | 47-50-47.724 | 66-26-58.297 |
| 87LFA5389 | 21O/16 | 304353 | 952589 | 47-52-20.790 | 66-26-30.570 |
| 87LFA5390 | 21O/16 | 305116 | 955397 | 47-53-51.673 | 66-25-53.721 |
| 87LFA5392 | 21O/16 | 307305 | 963255 | 47-58-05.978 | 66-24-07.871 |
| 87LFA5393 | 21O/16 | 305926 | 962716 | 47-57-48.560 | 66-25-14.388 |
| 87LFA5394 | 21O/16 | 304591 | 962261 | 47-57-33.869 | 66-26-18.731 |
| 87LFA5395 | 21O/16 | 302639 | 961449 | 47-57-07.647 | 66-27-52.853 |
| 87LFA5397 | 21O/16 | 300924 | 959775 | 47-56-13.456 | 66-29-15.479 |
| 87LFA5398 | 21O/16 | 302588 | 960103 | 47-56-24.068 | 66-27-55.322 |
| 87LFA5400 | 21O/16 | 306428 | 954021 | 47-53-07.075 | 66-24-50.624 |
| 87LFA5401 | 21O/16 | 308285 | 954066 | 47-53-08.453 | 66-23-21.269 |
| 87LFA5403 | 21O/16 | 300386 | 952290 | 47-52-11.136 | 66-29-41.406 |

## APPENDIX I: Sample Site Locations

| Sample Number | Map Sheet | X (mE) | Y (mN) | Lat. (N) | Long. (W) |
|---|---|---|---|---|---|
| 87LFA5404 | 21O/16 | 301267 | 954271 | 47-53-15.287 | 66-28-59.012 |
| 87LFA5405 | 21O/16 | 303473 | 955376 | 47-53-51.006 | 66-27-12.800 |
| 87LFA5406 | 21O/16 | 303962 | 956187 | 47-54-17.273 | 66-26-49.254 |
| 87LFA5407 | 21O/16 | 304876 | 957998 | 47-55-15.861 | 66-26-05.166 |
| 87LFA5408 | 21O/16 | 305736 | 959282 | 47-55-57.400 | 66-25-23.680 |
| 87LFA5409 | 21O/16 | 305945 | 957574 | 47-55-02.107 | 66-25-13.706 |
| 87LFA5410 | 21O/16 | 307762 | 958480 | 47-55-31.357 | 66-23-46.173 |
| 87LFA5411 | 21O/16 | 307127 | 961028 | 47-56-53.873 | 66-24-16.598 |
| 87LFA5417 | 21O/16 | 305547 | 943093 | 47-47-13.326 | 66-25-33.528 |
| 87LFA5418 | 21O/16 | 302904 | 942211 | 47-46-44.830 | 66-27-40.516 |
| 87LFA5419 | 21O/16 | 306582 | 950364 | 47-51-08.675 | 66-24-43.425 |
| 87LFA5420 | 21O/16 | 306563 | 947764 | 47-49-44.507 | 66-24-44.486 |
| 87LFA5421 | 21O/16 | 308204 | 948450 | 47-50-06.658 | 66-23-25.539 |
| 87LFA5422 | 21O/16 | 307471 | 953964 | 47-53-05.196 | 66-24-00.441 |
| 87LFA5423 | 21O/16 | 303183 | 952360 | 47-52-13.391 | 66-27-26.830 |
| 87LFA5424 | 21O/16 | 304659 | 950534 | 47-51-14.249 | 66-26-15.893 |
| 87LFA5425 | 21O/16 | 304248 | 947317 | 47-49-30.125 | 66-26-35.789 |
| 87LFA5426 | 21O/16 | 305801 | 948450 | 47-50-06.744 | 66-25-21.100 |
| 87LFA5427 | 21O/16 | 307728 | 948920 | 47-50-21.885 | 66-23-48.400 |
| 87LFA5429 | 21O/16 | 308702 | 954210 | 47-53-13.114 | 66-23-01.192 |
| 87LFA5430 | 21O/16 | 309872 | 956647 | 47-54-31.931 | 66-22-04.653 |
| ML980001 | 21O/15 | 290280 | 940320 | 47-45-43.393 | 66-37-46.700 |
| ML980002 | 21O/15 | 290343 | 940408 | 47-45-46.246 | 66-37-43.688 |
| ML980003 | 21O/15 | 290480 | 940373 | 47-45-45.105 | 66-37-37.110 |
| ML980004 | 21O/15 | 290579 | 940328 | 47-45-44.035 | 66-37-32.354 |
| ML980005 | 21O/15 | 290738 | 940378 | 47-45-45.270 | 66-37-24.707 |
| ML980006 | 21O/15 | 290979 | 940328 | 47-45-43.670 | 66-37-13.153 |
| ML980007 | 21O/15 | 291200 | 940325 | 47-45-43.579 | 66-37-02.540 |
| ML980008 | 21O/15 | 291436 | 940326 | 47-45-43.635 | 66-36-51.199 |
| ML980009 | 21O/15 | 291698 | 940340 | 47-45-44.086 | 66-36-38.639 |
| ML980010 | 21O/15 | 290119 | 940255 | 47-45-41.252 | 66-37-54.437 |
| ML980011 | 21O/15 | 290396 | 940320 | 47-45-43.375 | 66-37-41.128 |
| ML980012 | 21O/15 | 290501 | 940320 | 47-45-43.400 | 66-37-36.082 |
| ML980013 | 21O/15 | 290622 | 940321 | 47-45-43.441 | 66-37-30.267 |
| ML980014 | 21O/15 | 290696 | 940235 | 47-45-40.647 | 66-37-26.743 |
| ML980015 | 21O/15 | 290984 | 940213 | 47-45-39.939 | 66-37-12.891 |
| ML980016 | 21O/15 | 291698 | 940223 | 47-45-40.296 | 66-36-38.620 |
| ML980017 | 21O/15 | 290122 | 940132 | 47-45-37.297 | 66-37-54.280 |
| ML980018 | 21O/15 | 290253 | 940225 | 47-45-40.309 | 66-37-47.994 |
| ML980019 | 21O/15 | 290303 | 940225 | 47-45-40.292 | 66-37-45.592 |
| ML980020 | 21O/15 | 290378 | 940225 | 47-45-40.315 | 66-37-41.988 |
| ML980021 | 21O/15 | 290615 | 940179 | 47-45-38.816 | 66-37-30.622 |
| ML980022 | 21O/15 | 290253 | 940130 | 47-45-37.232 | 66-37-47.989 |
| ML980023 | 21O/15 | 290365 | 940075 | 47-45-35.436 | 66-37-42.594 |
| ML980024 | 21O/15 | 290481 | 940112 | 47-45-36.649 | 66-37-37.014 |
| ML980025 | 21O/15 | 290591 | 940112 | 47-45-36.670 | 66-37-31.777 |

## APPENDIX I: Sample Site Locations

| Sample Number | Map Sheet | X (mE) | Y (mN) | Lat. (N) | Long. (W) |
|---|---|---|---|---|---|
| ML980026 | 21O/15 | 290716 | 940157 | 47-45-38.132 | 66-37-25.753 |
| ML980027 | 21O/15 | 290989 | 940093 | 47-45-36.079 | 66-37-12.635 |
| ML980028 | 21O/15 | 291207 | 940098 | 47-45-36.250 | 66-37-02.154 |
| ML980029 | 21O/15 | 290228 | 940010 | 47-45-33.337 | 66-37-49.175 |
| ML980030 | 21O/15 | 290363 | 940010 | 47-45-33.332 | 66-37-42.690 |
| ML980031 | 21O/15 | 290435 | 939990 | 47-45-32.711 | 66-37-39.259 |
| ML980032 | 21O/15 | 290493 | 939957 | 47-45-31.648 | 66-37-36.425 |
| ML980033 | 21O/15 | 289485 | 940023 | 47-45-33.716 | 66-38-24.853 |
| ML980034 | 21O/15 | 290120 | 940027 | 47-45-33.897 | 66-37-54.338 |
| ML980035 | 21O/15 | 290197 | 939889 | 47-45-29.415 | 66-37-50.650 |
| ML980036 | 21O/15 | 290405 | 939894 | 47-45-29.597 | 66-37-40.650 |
| ML980037 | 21O/15 | 290568 | 939894 | 47-45-29.597 | 66-37-32.819 |
| ML980038 | 21O/15 | 290716 | 939900 | 47-45-29.807 | 66-37-25.748 |
| ML980039 | 21O/15 | 289978 | 939754 | 47-45-25.033 | 66-38-01.178 |
| ML980040 | 21O/15 | 290980 | 939599 | 47-45-20.084 | 66-37-13.028 |
| ML980041 | 21O/15 | 289440 | 939683 | 47-45-22.713 | 66-38-26.984 |
| ML980042 | 21O/15 | 289249 | 939307 | 47-45-10.527 | 66-38-36.133 |
| ML980043 | 21O/15 | 288549 | 939227 | 47-45-07.879 | 66-39-09.733 |
| ML980044 | 21O/15 | 290096 | 940519 | 47-45-49.795 | 66-37-55.538 |
| ML980045 | 21O/15 | 290479 | 940538 | 47-45-50.451 | 66-37-37.155 |
| ML980046 | 21O/15 | 290738 | 940533 | 47-45-50.291 | 66-37-24.718 |
| ML980047 | 21O/15 | 290972 | 940476 | 47-45-48.471 | 66-37-13.511 |
| ML980048 | 21O/15 | 291194 | 940440 | 47-45-47.311 | 66-37-02.850 |
| ML980049 | 21O/15 | 290297 | 940647 | 47-45-53.969 | 66-37-45.931 |
| ML980050 | 21O/15 | 290287 | 940775 | 47-45-58.126 | 66-37-46.415 |
| ML980051 | 21O/15 | 290980 | 940629 | 47-45-53.419 | 66-37-13.093 |
| ML980052 | 21O/15 | 291227 | 940629 | 47-45-53.433 | 66-37-01.273 |
| ML980053 | 21O/15 | 291455 | 940647 | 47-45-54.014 | 66-36-50.291 |
| ML980054 | 21O/15 | 291692 | 940456 | 47-45-47.849 | 66-36-38.899 |
| ML980055 | 21O/15 | 291941 | 940494 | 47-45-49.091 | 66-36-26.975 |
| ML980056 | 21O/15 | 292151 | 940536 | 47-45-50.467 | 66-36-16.870 |
| ML980057 | 21O/15 | 292658 | 940392 | 47-45-45.812 | 66-35-52.533 |
| ML980058 | 21O/15 | 292646 | 940184 | 47-45-39.085 | 66-35-53.083 |
| ML980059 | 21O/15 | 293068 | 940410 | 47-45-46.436 | 66-35-32.854 |
| ML980060 | 21O/15 | 293415 | 940200 | 47-45-39.639 | 66-35-16.161 |
| ML980061 | 21O/15 | 294361 | 940488 | 47-45-48.983 | 66-34-30.758 |
| ML980062 | 21O/15 | 294356 | 940190 | 47-45-39.334 | 66-34-30.966 |
| ML980063 | 21O/15 | 295311 | 939199 | 47-45-07.296 | 66-33-45.094 |
| ML980064 | 21O/15 | 291218 | 940775 | 47-45-58.171 | 66-37-01.681 |
| ML980065 | 21O/15 | 291455 | 940784 | 47-45-58.453 | 66-36-50.329 |
| ML980066 | 21O/15 | 291673 | 940658 | 47-45-54.380 | 66-36-39.849 |
| ML980067 | 21O/15 | 291935 | 940660 | 47-45-54.474 | 66-36-27.256 |
| ML980068 | 21O/15 | 290731 | 940911 | 47-46-02.543 | 66-37-25.073 |
| ML980069 | 21O/15 | 290980 | 940916 | 47-46-02.717 | 66-37-13.149 |
| ML980070 | 21O/15 | 291208 | 940920 | 47-46-02.846 | 66-37-02.188 |
| ML980071 | 21O/15 | 291455 | 940939 | 47-46-03.474 | 66-36-50.339 |

## APPENDIX I: Sample Site Locations

| Sample Number | Map Sheet | X (mE) | Y (mN) | Lat. (N) | Long. (W) |
|---|---|---|---|---|---|
| ML980072 | 21O/15 | 291692 | 940939 | 47-46-03.497 | 66-36-38.950 |
| ML980073 | 21O/15 | 291920 | 940920 | 47-46-02.879 | 66-36-27.976 |
| ML980074 | 21O/15 | 292111 | 940929 | 47-46-03.174 | 66-36-18.833 |
| ML980075 | 21O/15 | 292665 | 940763 | 47-45-57.824 | 66-35-52.220 |
| ML980076 | 21O/15 | 293096 | 940665 | 47-45-54.668 | 66-35-31.513 |
| ML980077 | 21O/15 | 294370 | 940615 | 47-45-53.088 | 66-34-30.327 |
| ML980078 | 21O/15 | 291208 | 941066 | 47-46-07.576 | 66-37-02.212 |
| ML980079 | 21O/15 | 291455 | 941084 | 47-46-08.171 | 66-36-50.316 |
| ML980080 | 21O/15 | 291683 | 941066 | 47-46-07.587 | 66-36-39.388 |
| ML980081 | 21O/15 | 291901 | 941075 | 47-46-07.887 | 66-36-28.899 |
| ML980082 | 21O/15 | 293412 | 940612 | 47-45-52.957 | 66-35-16.361 |
| ML980083 | 21O/15 | 290725 | 941221 | 47-46-12.560 | 66-37-25.385 |
| ML980084 | 21O/15 | 290962 | 941221 | 47-46-12.584 | 66-37-14.044 |
| ML980085 | 21O/15 | 291208 | 941221 | 47-46-12.597 | 66-37-02.223 |
| ML980086 | 21O/15 | 291464 | 941221 | 47-46-12.601 | 66-36-49.921 |
| ML980087 | 21O/15 | 291683 | 941221 | 47-46-12.609 | 66-36-39.398 |
| ML980088 | 21O/15 | 291892 | 941230 | 47-46-12.917 | 66-36-29.341 |
| ML980089 | 21O/15 | 292138 | 941239 | 47-46-13.222 | 66-36-17.554 |
| ML980090 | 21O/15 | 292758 | 941298 | 47-46-15.158 | 66-35-47.769 |
| ML980091 | 21O/15 | 293184 | 941321 | 47-46-15.928 | 66-35-27.312 |
| ML980092 | 21O/15 | 294380 | 940773 | 47-45-58.228 | 66-34-29.848 |
| ML980093 | 21O/15 | 295170 | 940538 | 47-45-50.622 | 66-33-51.909 |
| ML980094 | 21O/15 | 291208 | 941422 | 47-46-19.108 | 66-37-02.213 |
| ML980095 | 21O/15 | 291226 | 941589 | 47-46-24.501 | 66-37-01.390 |
| ML980096 | 21O/15 | 291474 | 941594 | 47-46-24.674 | 66-36-49.465 |
| ML980097 | 21O/15 | 291726 | 941589 | 47-46-24.519 | 66-36-37.362 |
| ML980098 | 21O/15 | 291913 | 941589 | 47-46-24.527 | 66-36-28.376 |
| ML980099 | 21O/15 | 292142 | 941594 | 47-46-24.718 | 66-36-17.363 |
| ML980100 | 21O/15 | 292777 | 941575 | 47-46-24.113 | 66-35-46.876 |
| ML980101 | 21O/15 | 293151 | 941569 | 47-46-23.930 | 66-35-28.912 |
| ML980102 | 21O/15 | 293539 | 941541 | 47-46-23.053 | 66-35-10.308 |
| ML980103 | 21O/15 | 294459 | 941320 | 47-46-15.933 | 66-34-26.093 |
| ML980104 | 21O/15 | 293539 | 941835 | 47-46-32.577 | 66-35-10.299 |
| ML980105 | 21O/15 | 294347 | 941679 | 47-46-27.548 | 66-34-31.511 |
| ML980106 | 21O/15 | 294524 | 942431 | 47-46-51.890 | 66-34-23.025 |
| ML980107 | 21O/15 | 294421 | 942865 | 47-47-05.957 | 66-34-27.994 |
| ML980108 | 21O/15 | 295753 | 941891 | 47-46-34.440 | 66-33-23.959 |
| ML980109 | 21O/15 | 289188 | 941135 | 47-46-09.709 | 66-38-39.224 |
| ML980110 | 21O/15 | 293410 | 940434 | 47-45-47.225 | 66-35-16.434 |
| MP990001 | 21O/16 | 300675 | 961478 | 47-57-08.592 | 66-29-27.464 |
| MP990002 | 21O/16 | 301210 | 958219 | 47-55-23.074 | 66-29-01.727 |
| MP990003 | 21O/16 | 301213 | 956195 | 47-54-17.571 | 66-29-01.580 |
| MP990005 | 21O/16 | 301268 | 950204 | 47-51-03.607 | 66-28-59.037 |
| MP990006 | 21O/16 | 301290 | 948134 | 47-49-56.594 | 66-28-57.998 |
| MP990007 | 21O/16 | 301205 | 940218 | 47-45-40.319 | 66-29-02.161 |
| MP990008 | 21O/16 | 304289 | 960242 | 47-56-28.533 | 66-26-33.339 |

## APPENDIX I: Sample Site Locations

| Sample Number | Map Sheet | X (mE) | Y (mN) | Lat. (N) | Long. (W) |
|---|---|---|---|---|---|
| MP990009 | 21O/16 | 303234 | 958219 | 47-55-23.063 | 66-27-24.232 |
| MP990010 | 21O/16 | 305409 | 951391 | 47-51-41.981 | 66-25-39.819 |
| MP990011 | 21O/16 | 305289 | 949301 | 47-50-34.312 | 66-25-45.670 |
| MP990012 | 21O/16 | 303117 | 944086 | 47-47-45.537 | 66-27-30.250 |
| MP990013 | 21O/16 | 303254 | 940208 | 47-45-39.995 | 66-27-23.783 |
| MP990014 | 21O/16 | 305298 | 940248 | 47-45-41.241 | 66-25-45.617 |
| MP990016 | 21O/16 | 306030 | 961899 | 47-57-22.112 | 66-25-09.387 |
| MP990017 | 21O/16 | 307222 | 956225 | 47-54-18.383 | 66-24-12.287 |
| MP990018 | 21O/16 | 307270 | 952218 | 47-52-08.663 | 66-24-10.203 |
| MP990019 | 21O/16 | 307231 | 949288 | 47-50-33.829 | 66-24-12.294 |
| MP990020 | 21O/16 | 308315 | 945058 | 47-48-16.823 | 66-23-20.419 |
| MP990021 | 21O/16 | 307346 | 966221 | 47-59-41.975 | 66-24-05.704 |
| MP990022 | 21O/16 | 309336 | 966229 | 47-59-42.157 | 66-22-29.753 |
| MP990023 | 21O/16 | 309306 | 964249 | 47-58-38.055 | 66-22-31.364 |
| MP990024 | 21O/16 | 309581 | 962725 | 47-57-48.709 | 66-22-18.191 |
| MP990025 | 21O/16 | 309249 | 960238 | 47-56-28.225 | 66-22-34.375 |
| MP990026 | 21O/16 | 310276 | 958227 | 47-55-23.053 | 66-21-45.094 |
| MP990027 | 21O/16 | 311266 | 954213 | 47-53-13.067 | 66-20-57.760 |
| MP990028 | 21O/16 | 311224 | 951609 | 47-51-48.766 | 66-21-00.040 |
| MP990029 | 21O/16 | 309277 | 950595 | 47-51-16.032 | 66-22-33.782 |
| MP990030 | 21O/16 | 309562 | 942126 | 47-46-41.840 | 66-22-20.730 |
| MP990031 | 21O/16 | 311226 | 940207 | 47-45-39.622 | 66-21-00.991 |
| MP990033 | 21O/16 | 311300 | 964252 | 47-58-38.048 | 66-20-55.214 |
| MP990034 | 21O/16 | 311372 | 962139 | 47-57-29.621 | 66-20-51.918 |
| MP990035 | 21O/16 | 311258 | 960216 | 47-56-27.395 | 66-20-57.610 |
| MP990036 | 21O/16 | 313247 | 956250 | 47-54-18.877 | 66-19-22.235 |
| MP990037 | 21O/16 | 313562 | 954327 | 47-53-16.590 | 66-19-07.243 |
| MP990038 | 21O/16 | 314281 | 952242 | 47-52-09.021 | 66-18-32.890 |
| MP990039 | 21O/16 | 314167 | 949768 | 47-50-48.949 | 66-18-38.671 |
| MP990040 | 21O/16 | 313163 | 948451 | 47-50-06.381 | 66-19-27.109 |
| MP990041 | 21O/16 | 313822 | 942151 | 47-46-42.382 | 66-18-56.112 |
| MP990042 | 21O/16 | 313516 | 944876 | 47-48-10.638 | 66-19-10.508 |
| MP990043 | 21O/16 | 313328 | 966252 | 47-59-42.633 | 66-19-17.215 |
| MP990044 | 21O/16 | 313321 | 964231 | 47-58-37.210 | 66-19-17.755 |
| MP990045 | 21O/16 | 315137 | 960061 | 47-56-22.097 | 66-17-50.733 |
| MP990046 | 21O/16 | 316254 | 956236 | 47-54-18.163 | 66-16-57.451 |
| MP990047 | 21O/16 | 316328 | 954260 | 47-53-14.203 | 66-16-54.153 |
| MP990048 | 21O/16 | 315263 | 943847 | 47-47-37.183 | 66-17-46.706 |
| MP990049 | 21O/16 | 316727 | 939351 | 47-45-11.507 | 66-16-36.968 |
| MP990050 | 21O/16 | 315316 | 966259 | 47-59-42.716 | 66-17-41.315 |
| MP990052 | 21O/16 | 317974 | 962090 | 47-57-27.492 | 66-15-33.782 |
| MP990053 | 21O/16 | 317188 | 957509 | 47-54-59.301 | 66-16-12.312 |
| MP990054 | 21O/16 | 318175 | 956249 | 47-54-18.391 | 66-15-24.938 |
| MP990055 | 21O/16 | 317958 | 953858 | 47-53-01.033 | 66-15-35.768 |
| MP990056 | 21O/16 | 317622 | 948448 | 47-50-05.925 | 66-15-52.695 |
| MP990060 | 21O/10 | 283211 | 938252 | 47-44-35.918 | 66-43-25.854 |

## APPENDIX I: Sample Site Locations

| Sample Number | Map Sheet | X (mE) | Y (mN) | Lat. (N) | Long. (W) |
|---|---|---|---|---|---|
| MP990061 | 21O/10 | 285201 | 938228 | 47-44-35.307 | 66-41-50.309 |
| MP990062 | 21O/10 | 287200 | 938223 | 47-44-35.313 | 66-40-14.352 |
| MP990063 | 21O/10 | 289226 | 938219 | 47-44-35.303 | 66-38-37.147 |
| MP990064 | 21O/10 | 291234 | 938212 | 47-44-35.191 | 66-37-00.764 |
| MP990065 | 21O/10 | 293229 | 938203 | 47-44-34.972 | 66-35-25.009 |
| MP990066 | 21O/10 | 295262 | 938194 | 47-44-34.757 | 66-33-47.430 |
| MP990067 | 21O/10 | 297269 | 938217 | 47-44-35.550 | 66-32-11.100 |
| MP990068 | 21O/10 | 299246 | 938196 | 47-44-34.861 | 66-30-36.184 |

# APPENDIX II

## SITE CHARACTERISTICS AND GRANULOMETRIC ANALYSIS

Site characteristics were determined for the 171 samples collected during the 1998 and 1999 field seasons. Till matrix texture and consistency, as well as local drainage were determined using criteria outlined by Zelanzny et al. (1989). Numerical values were assigned to the field observations to allow for statistical analysis of the data. The following numbering system was used to quantify the field observations:

Texture: Numbers increase with increasing fine particle content.

| | | | |
|---|---|---|---|
| Sand | 1 | Silt Clay Loam | 6 |
| Sandy loam | 2 | Clay Loam | 7 |
| Silt Loam | 3 | Sandy Clay | 8 |
| Loam | 4 | Silty Clay | 9 |
| Sandy Clay Loam | 5 | Clay | 10 |

Consistency: Numbers increase with increasing till compactness.

| | | | |
|---|---|---|---|
| Loose | 1 | Friable | 3 |
| Very Friable | 2 | Firm | 4 |

Drainage: Numbers increase with increasingly poor drainage.

| | | | |
|---|---|---|---|
| Rapidly | 1 | Imperfectly | 4 |
| Well | 2 | Poorly | 5 |
| Moderately Well | 3 | Very Poor | 6 |

Granulometric analysis was also performed on the 171 samples. Exactly 100 grams of the <2 mm fraction of each matrix sample were dispersed in a 5% Calgon® solution. Hydrometer readings were taken to determine the sand (2.00 - 0.05 mm), silt ( 0.05 - 0.004 mm), and clay (<0.004 mm) fractions of the till (after Bouyoucos, 1962).

| Sample Site | Field Data | | | Granulometric Analysis | | |
|---|---|---|---|---|---|---|
| | Texture | Consistency | Local Drainage | Sand wt% | Silt wt% | Clay wt% |


| Sample Site | Field Data | | | Granulometric Analysis | | |
|---|---|---|---|---|---|---|
| | Texture | Consistency | Local Drainage | Sand wt% | Silt wt% | Clay wt% |


| | | | | | | |
|---|---|---|---|---|---|---|
| ML980001 | 3 | 2 | 2 | 44 | 44 | 12 |
| ML980002 | 5 | 3 | 2 | 48 | 40 | 12 |
| ML980003 | 5 | 3 | 2 | 48 | 44 | 8 |
| ML980004 | 3 | 3 | 3 | 43 | 46 | 11 |
| ML980005 | 3 | 3 | 3 | 47 | 45 | 8 |
| ML980006 | 3 | 3 | 2 | 42 | 50 | 8 |
| ML980007 | 2 | 3 | 2 | 48 | 44 | 8 |
| ML980008 | 3 | 3 | 2 | 44 | 46 | 10 |
| ML980009 | 3 | 2 | 2 | 54 | 42 | 4 |
| ML980010 | 3 | 2 | 2 | 45 | 44 | 11 |
| ML980011 | 5 | 3 | 2 | 44 | 45 | 11 |
| ML980012 | 5 | 2 | 2 | 48 | 43 | 9 |
| ML980013 | 2 | 3 | 3 | 48 | 44 | 8 |
| ML980014 | 2 | 3 | 2 | 42 | 53 | 5 |
| ML980015 | 4 | 2 | 2 | 52 | 41 | 7 |
| ML980016 | 2 | 2 | 1 | 49 | 40 | 11 |
| ML980017 | 3 | 2 | 2 | 49 | 39 | 12 |
| ML980018 | 5 | 2 | 2 | 48 | 42 | 10 |
| ML980019 | 2 | 2 | 2 | 40 | 46 | 14 |
| ML980020 | 2 | 2 | 2 | 44 | 47 | 9 |
| ML980021 | 2 | 2 | 2 | 46 | 44 | 10 |
| ML980022 | 3 | 3 | 2 | 47 | 43 | 10 |
| ML980023 | 3 | 2 | 2 | 59 | 34 | 7 |
| ML980024 | 6 | 3 | 3 | 46 | 44 | 10 |
| ML980025 | 5 | 3 | 3 | 44 | 42 | 14 |
| ML980026 | 5 | 3 | 3 | 50 | 42 | 8 |
| ML980027 | 4 | 3 | 2 | 46 | 46 | 8 |
| ML980028 | 2 | 2 | 1 | 57 | 35 | 8 |
| ML980029 | 2 | 2 | 2 | 51 | 37 | 12 |
| ML980030 | 2 | 2 | 3 | 44 | 44 | 12 |
| ML980031 | 6 | 2 | 2 | 55 | 35 | 10 |
| ML980032 | 3 | 3 | 2 | 50 | 39 | 11 |
| ML980033 | 6 | 2 | 2 | 39 | 43 | 18 |
| ML980034 | 3 | 3 | 2 | 39 | 49 | 12 |
| ML980035 | 5 | 3 | 2 | 43 | 48 | 9 |
| ML980036 | 2 | 2 | 2 | 48 | 36 | 16 |
| ML980037 | 5 | 2 | 2 | 44 | 42 | 14 |
| ML980038 | 5 | 3 | 3 | 42 | 47 | 11 |
| ML980039 | 5 | 3 | 2 | 41 | 48 | 11 |
| ML980040 | 5 | 3 | 3 | 33 | 55 | 12 |
| ML980041 | 5 | 3 | 2 | 27 | 38 | 35 |
| ML980042 | 5 | 2 | 3 | 50 | 40 | 10 |

| Sample Site | Field Data | | | Granulometric Analysis | | |
|---|---|---|---|---|---|---|
| | Texture | Consistency | Local Drainage | Sand wt% | Silt wt% | Clay wt% |
| ML980043 | 5 | 2 | 3 | 61 | 29 | 10 |
| ML980044 | 5 | 3 | 2 | 45 | 45 | 10 |
| ML980045 | 5 | 3 | 2 | 45 | 47 | 8 |
| ML980046 | 6 | 3 | 3 | 45 | 47 | 8 |
| ML980047 | 5 | 3 | 3 | 45 | 50 | 5 |
| ML980048 | 2 | 2 | 1 | 54 | 38 | 8 |
| ML980049 | 5 | 3 | 2 | 45 | 47 | 8 |
| ML980050 | 3 | 2 | 2 | 49 | 44 | 7 |
| ML980051 | 3 | 2 | 2 | 47 | 48 | 5 |
| ML980052 | 3 | 2 | 2 | 56 | 40 | 4 |
| ML980053 | 2 | 2 | 2 | 44 | 48 | 8 |
| ML980054 | 3 | 2 | 1 | 42 | 50 | 8 |
| ML980055 | 3 | 3 | 2 | 50 | 43 | 7 |
| ML980056 | 2 | 2 | 2 | 45 | 47 | 8 |
| ML980057 | 2 | 2 | 2 | 52 | 45 | 3 |
| ML980058 | 3 | 3 | 2 | 50 | 42 | 8 |
| ML980059 | 5 | 2 | 1 | 57 | 34 | 9 |
| ML980060 | 5 | 3 | 2 | 55 | 38 | 7 |
| ML980061 | 3 | 2 | 2 | 46 | 45 | 9 |
| ML980062 | 6 | 3 | 3 | 37 | 46 | 17 |
| ML980063 | 6 | 3 | 2 | 52 | 43 | 5 |
| ML980064 | 3 | 2 | 2 | 52 | 44 | 4 |
| ML980065 | 3 | 2 | 1 | 42 | 53 | 5 |
| ML980066 | 5 | 3 | 2 | 52 | 43 | 5 |
| ML980067 | 3 | 3 | 2 | 52 | 42 | 6 |
| ML980068 | 3 | 2 | 2 | 47 | 45 | 8 |
| ML980069 | 2 | 2 | 2 | 58 | 38 | 4 |
| ML980070 | 5 | 2 | 2 | 37 | 59 | 4 |
| ML980071 | 2 | 2 | 1 | 70 | 27 | 3 |
| ML980072 | 7 | 3 | 4 | 34 | 58 | 8 |
| ML980073 | 3 | 3 | 2 | 56 | 38 | 6 |
| ML980074 | 3 | 3 | 2 | 47 | 47 | 6 |
| ML980075 | 3 | 2 | 2 | 42 | 50 | 8 |
| ML980076 | 6 | 3 | 3 | 42 | 46 | 12 |
| ML980077 | 6 | 3 | 2 | 47 | 45 | 8 |
| ML980078 | 5 | 2 | 2 | 45 | 47 | 8 |
| ML980079 | 2 | 2 | 2 | 60 | 34 | 6 |
| ML980080 | 2 | 3 | 2 | 57 | 36 | 7 |
| ML980081 | 3 | 3 | 2 | 51 | 41 | 8 |
| ML980082 | 3 | 2 | 3 | 52 | 40 | 8 |
| ML980083 | 2 | 2 | 2 | 41 | 50 | 9 |
| ML980084 | 3 | 2 | 2 | 60 | 37 | 3 |
| ML980085 | 5 | 2 | 2 | 55 | 39 | 6 |
| ML980086 | 5 | 3 | 2 | 57 | 38 | 5 |
| ML980087 | 2 | 3 | 3 | 52 | 43 | 5 |
| ML980088 | 2 | 3 | 2 | 68 | 30 | 2 |

| Sample Site | Field Data | | | Granulometric Analysis | | |
|---|---|---|---|---|---|---|
| | Texture | Consistency | Local Drainage | Sand wt% | Silt wt% | Clay wt% |
| ML980089 | 2 | 3 | 2 | 60 | 35 | 5 |
| ML980090 | 2 | 2 | 2 | 62 | 33 | 5 |
| ML980091 | 3 | 3 | 2 | 47 | 46 | 7 |
| ML980092 | 2 | 2 | 3 | 64 | 31 | 5 |
| ML980093 | 3 | 3 | 3 | 39 | 47 | 14 |
| ML980094 | 6 | 3 | 2 | 43 | 52 | 5 |
| ML980095 | 5 | 2 | 2 | 54 | 45 | 1 |
| ML980096 | 5 | 2 | 2 | 51 | 46 | 3 |
| ML980097 | 5 | 2 | 2 | 40 | 48 | 12 |
| ML980098 | 3 | 3 | 2 | 52 | 45 | 3 |
| ML980099 | 3 | 3 | 3 | 43 | 54 | 3 |
| ML980100 | 3 | 3 | 2 | 69 | 27 | 4 |
| ML980101 | 2 | 3 | 3 | 50 | 41 | 9 |
| ML980102 | 3 | 3 | 2 | 48 | 46 | 6 |
| ML980103 | 2 | 2 | 2 | 65 | 31 | 4 |
| ML980104 | 2 | 3 | 3 | 63 | 30 | 7 |
| ML980105 | 2 | 3 | 3 | 45 | 47 | 8 |
| ML980106 | 3 | 2 | 2 | 52 | 41 | 7 |
| ML980107 | 3 | 2 | 3 | 37 | 47 | 16 |
| ML980108 | 2 | 2 | 2 | 61 | 28 | 11 |
| ML980109 | 6 | 3 | 2 | 45 | 34 | 21 |
| ML980110 | 3 | 3 | 1 | 57 | 36 | 7 |
| MP990001 | 5 | 3 | 2 | 47 | 34 | 19 |
| MP990002 | 5 | 3 | 2 | 43 | 45 | 12 |
| MP990003 | 5 | 2 | 3 | 50 | 33 | 17 |
| MP990005 | 5 | 3 | 2 | 65 | 30 | 5 |
| MP990006 | 5 | 3 | 3 | 44 | 50 | 6 |
| MP990007 | 6 | 3 | 2 | 39 | 53 | 8 |
| MP990008 | 5 | 3 | 2 | 38 | 44 | 18 |
| MP990009 | 5 | 3 | 2 | 41 | 46 | 13 |
| MP990010 | 5 | 3 | 2 | 41 | 52 | 7 |
| MP990011 | 3 | 3 | 2 | 53 | 38 | 9 |
| MP990012 | 5 | 3 | 3 | 42 | 49 | 9 |
| MP990013 | 5 | 3 | 2 | 39 | 52 | 9 |
| MP990014 | 6 | 3 | 2 | 54 | 39 | 7 |
| MP990016 | 5 | 2 | 2 | 35 | 36 | 29 |
| MP990017 | 2 | 2 | 2 | 70 | 23 | 7 |
| MP990018 | 5 | 3 | 2 | 48 | 43 | 9 |
| MP990019 | 2 | 2 | 2 | 58 | 34 | 8 |
| MP990020 | 2 | 2 | 2 | 64 | 31 | 5 |
| MP990021 | 5 | 2 | 3 | 40 | 43 | 17 |
| MP990022 | 5 | 2 | 2 | 63 | 23 | 14 |
| MP990023 | 5 | 2 | 2 | 51 | 27 | 22 |
| MP990024 | 5 | 2 | 2 | 59 | 33 | 8 |
| MP990025 | 5 | 3 | 2 | 44 | 38 | 18 |
| MP990026 | 6 | 3 | 3 | 42 | 39 | 19 |

| Sample Site | Field Data | | | Granulometric Analysis | | |
|---|---|---|---|---|---|---|
| | Texture | Consistency | Local Drainage | Sand wt% | Silt wt% | Clay wt% |
| MP990027 | 5 | 2 | 2 | 52 | 41 | 7 |
| MP990028 | 6 | 3 | 2 | 42 | 49 | 9 |
| MP990029 | 5 | 2 | 2 | 47 | 42 | 11 |
| MP990030 | 5 | 2 | 2 | 47 | 43 | 10 |
| MP990031 | 5 | 3 | 2 | 53 | 40 | 7 |
| MP990033 | 5 | 3 | 2 | 46 | 39 | 15 |
| MP990034 | 6 | 3 | 2 | 51 | 42 | 7 |
| MP990035 | 5 | 3 | 2 | 54 | 30 | 16 |
| MP990036 | 5 | 3 | 3 | 50 | 36 | 14 |
| MP990037 | 5 | 2 | 2 | 80 | 17 | 3 |
| MP990038 | 6 | 3 | 3 | 61 | 33 | 6 |
| MP990039 | 5 | 3 | 2 | 45 | 36 | 19 |
| MP990040 | 6 | 3 | 2 | 44 | 45 | 11 |
| MP990041 | 6 | 3 | 2 | 30 | 63 | 7 |
| MP990042 | 5 | 4 | 2 | 38 | 55 | 7 |
| MP990043 | 5 | 2 | 2 | 74 | 17 | 9 |
| MP990044 | 2 | 3 | 2 | 79 | 12 | 9 |
| MP990045 | 5 | 2 | 2 | 46 | 37 | 17 |
| MP990046 | 6 | 2 | 2 | 54 | 33 | 13 |
| MP990047 | 6 | 3 | 2 | 54 | 31 | 15 |
| MP990048 | 5 | 3 | 2 | 44 | 51 | 5 |
| MP990049 | 2 | 2 | 2 | 65 | 30 | 5 |
| MP990050 | 5 | 3 | 2 | 64 | 24 | 12 |
| MP990052 | 6 | 3 | 2 | 42 | 43 | 15 |
| MP990053 | 6 | 3 | 3 | 41 | 41 | 18 |
| MP990054 | 6 | 3 | 2 | 45 | 44 | 11 |
| MP990055 | 6 | 3 | 2 | 50 | 37 | 13 |
| MP990056 | 6 | 3 | 3 | 56 | 39 | 5 |
| MP990060 | 5 | 3 | 2 | 43 | 48 | 9 |
| MP990061 | 5 | 2 | 2 | 49 | 37 | 14 |
| MP990062 | 5 | 3 | 2 | 59 | 31 | 10 |
| MP990063 | 6 | 3 | 2 | 41 | 50 | 9 |
| MP990064 | 5 | 2 | 2 | 83 | 12 | 5 |
| MP990065 | 6 | 2 | 2 | 47 | 35 | 18 |
| MP990066 | 6 | 2 | 2 | 52 | 41 | 7 |
| MP990067 | 5 | 2 | 3 | 41 | 44 | 15 |
| MP990068 | 6 | 3 | 2 | 52 | 45 | 3 |

# APPENDIX III

## TILL CLAST LITHOLOGICAL ANALYSIS

Lithological analyses were performed on clasts obtained from 171 sample sites. Approximately 25-100 clasts, varying in size from 2 cm to 10 cm, were collected from the C-horizon at each site.

Clasts were catergorized into the following lithological groups:

1. Sedimentary - sandstone/siltstone, limestone, conglomerate, and chert
2. Igneous intrusive - granite and gabbro
3. Igneous extrusive - rhyolite and basalt
4. Metamorphic - skarn and hornfels
5. Quartz pieces
6. Mineralized clasts

The relative abundances of each group are expressed as percentages of the total number of clasts collected at each site. The lithological data were contoured using Surfer® 6.01 and compared with bedrock units and mineral occurrences.

| Sample | Sedimentary | | | | Igneous Intrusive | | Igneous Extrusive | | Metamorphic | | Quartz Pieces | Mineral |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | sst/silt | lst | congl. | chert | granite | gabbro | rhyolite | basalt | skarn | hornfels | | |
| Sample | Sedimentary | | | | Igneous Intrusive | | Igneous Extrusive | | Metamorphic | | Quartz Pieces | Mineral |
| | sst/silt | lst | congl. | chert | granite | gabbro | rhyolite | basalt | skarn | hornfels | | |
| ML980001 | 0.02 | | | | 0.95 | | | | 0.02 | 0.01 | | 0.00 |
| ML980002 | 0.29 | | | | 0.65 | | | | 0.01 | 0.05 | | 0.00 |
| ML980003 | 0.31 | | | | 0.67 | | | | | 0.02 | | 0.00 |
| ML980004 | 0.01 | | | | 0.94 | | | | 0.02 | 0.03 | | 0.00 |
| ML980005 | 0.03 | | | | 0.93 | | | | 0.01 | 0.03 | | 0.00 |
| ML980006 | 0.48 | | | | 0.49 | | | | | 0.03 | | 0.15 |
| ML980007 | 0.64 | | | | 0.34 | | | | | 0.02 | | 0.07 |
| ML980008 | 0.87 | | | | 0.12 | | | | | 0.01 | | 0.02 |
| ML980009 | 0.91 | | | | 0.08 | | | | | 0.01 | | 0.02 |
| ML980010 | 0.10 | | | | 0.89 | | | | | 0.01 | | 0.00 |
| ML980011 | | | | | 0.98 | | | | 0.01 | 0.01 | | 0.00 |
| ML980012 | | | | | 1.00 | | | | | | | 0.00 |
| ML980013 | 0.01 | | | | 0.95 | | | | | 0.04 | | 0.00 |
| ML980014 | 0.56 | | | | 0.43 | | | | | 0.01 | | 0.01 |
| ML980015 | 0.68 | | | | 0.32 | | | | | | | 0.05 |
| ML980016 | 0.94 | | | | 0.06 | | | | | | | 0.03 |
| ML980017 | | | | | 0.99 | | | | | 0.01 | | 0.00 |
| ML980018 | | | | | 1.00 | | | | | | | 0.00 |
| ML980019 | | | | | 1.00 | | | | | | | 0.00 |
| ML980020 | 0.01 | | | | 0.96 | | | | 0.01 | 0.02 | | 0.00 |
| ML980021 | 0.01 | | | | 0.96 | | | | | 0.03 | | 0.00 |
| ML980022 | | | | | 0.98 | | | | | 0.02 | | 0.00 |
| ML980023 | | | | | 1.00 | | | | | | | 0.00 |
| ML980024 | 0.03 | | | | 0.94 | | | | | 0.03 | | 0.00 |
| ML980025 | 0.06 | | | | 0.92 | | | | | 0.02 | | 0.00 |
| ML980026 | 0.07 | | | | 0.91 | | | | | 0.02 | | 0.00 |
| ML980027 | 0.31 | | | | 0.69 | | | | | | | 0.20 |
| ML980028 | 0.63 | | | | 0.37 | | | | | | | 0.09 |
| ML980029 | | | | | 0.99 | | | | 0.01 | | | 0.00 |
| ML980030 | | | | | 1.00 | | | | | | | 0.00 |
| ML980031 | | | | | 1.00 | | | | | | | 0.00 |
| ML980032 | | | | | 0.98 | | | | 0.01 | 0.01 | | 0.00 |
| ML980033 | | 0.91 | | | 0.09 | | | | | | | 0.00 |
| ML980034 | | | | | 1.00 | | | | | | | 0.00 |
| ML980035 | | | | | 1.00 | | | | | | | 0.00 |
| ML980036 | | | | | 1.00 | | | | | | | 0.00 |
| ML980037 | | | | | 0.99 | | | | | 0.01 | | 0.00 |
| ML980038 | 0.01 | | | | 0.98 | | | | | 0.01 | | 0.00 |
| ML980039 | | 0.01 | | | 0.99 | | | | | | | 0.00 |
| ML980040 | 0.52 | | | | 0.47 | | | | | 0.01 | | 0.00 |
| ML980041 | 0.87 | | | | 0.13 | | | | | | | 0.00 |
| ML980042 | 0.49 | | | | 0.49 | | | | | 0.02 | | 0.00 |
| ML980043 | 0.56 | 0.36 | | 0.02 | 0.06 | | | | | | | 0.00 |
| ML980044 | 0.08 | 0.76 | | | 0.16 | | | | | | | 0.00 |
| ML980045 | 0.64 | 0.03 | | | 0.32 | | | | | 0.01 | | 0.00 |

| Sample | Sedimentary | | | | Igneous Intrusive | | Igneous Extrusive | | Metamorphic | | Quartz | Mineral |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | sst/silt | lst | congl. | chert | granite | gabbro | rhyolite | basalt | skarn | hornfels | Pieces | |
| ML980046 | 0.59 | 0.02 | | | 0.38 | | | | | 0.01 | | 0.00 |
| ML980047 | 0.54 | | | | 0.46 | | | | | | | 0.00 |
| ML980048 | 0.57 | | | | 0.43 | | | | | | | 0.03 |
| ML980049 | 0.32 | 0.35 | | 0.01 | 0.32 | | | | | | | 0.00 |
| ML980050 | 0.37 | 0.43 | | | 0.20 | | | | | | | 0.00 |
| ML980051 | 0.51 | 0.02 | | | 0.47 | | | | | | | 0.00 |
| ML980052 | 0.52 | 0.01 | | | 0.47 | | | | | | | 0.00 |
| ML980053 | 0.56 | | | | 0.42 | | | | | 0.02 | | 0.00 |
| ML980054 | 0.79 | | | | 0.21 | | | | | | | 0.00 |
| ML980055 | 0.76 | | | | 0.22 | | | | | 0.02 | | 0.00 |
| ML980056 | 0.78 | | | | 0.22 | | | | | | | 0.00 |
| ML980057 | 0.92 | | | | 0.08 | | | | | | | 0.00 |
| ML980058 | 0.95 | | | | 0.05 | | | | | | | 0.00 |
| ML980059 | 0.93 | | | | 0.03 | | | | | | 0.04 | 0.00 |
| ML980060 | 0.91 | | | | 0.04 | | | | | 0.01 | 0.04 | 0.00 |
| ML980061 | 0.41 | | | | 0.59 | | | | | | | 0.00 |
| ML980062 | 0.79 | | | | 0.21 | | | | | | | 0.00 |
| ML980063 | 0.91 | | | | 0.09 | | | | | | | 0.00 |
| ML980064 | 0.62 | | | 0.01 | 0.37 | | | | | | | 0.00 |
| ML980065 | 0.73 | | | 0.02 | 0.24 | | | | | | | 0.00 |
| ML980066 | 0.87 | | | 0.02 | 0.10 | | | | | | 0.01 | 0.00 |
| ML980067 | 0.79 | | | | 0.20 | | | | 0.01 | | | 0.21 |
| ML980068 | 0.26 | 0.52 | | | 0.22 | | | | | | | 0.00 |
| ML980069 | 0.23 | 0.58 | | | 0.19 | | | | | | | 0.00 |
| ML980070 | 0.90 | | | | 0.10 | | | | | | | 0.00 |
| ML980071 | 0.16 | | | | 0.68 | | | | | | 0.16 | 0.00 |
| ML980072 | 0.23 | | | | 0.08 | 0.69 | | | | | | 0.00 |
| ML980073 | 0.51 | | | | 0.49 | | | | | | | 0.15 |
| ML980074 | 0.67 | | | 0.05 | 0.29 | | | | | | | 0.11 |
| ML980075 | 0.49 | | | 0.16 | 0.32 | 0.03 | | | | | | 0.17 |
| ML980076 | 0.59 | | | | 0.41 | | | | | | | 0.00 |
| ML980077 | 0.58 | | | | 0.43 | | | | | | | 0.00 |
| ML980078 | 0.85 | | | | 0.15 | | | | | | | 0.00 |
| ML980079 | 0.28 | | | 0.10 | 0.60 | | | | | | 0.01 | 0.00 |
| ML980080 | 0.68 | | | 0.27 | | 0.05 | | | | | | 0.00 |
| ML980081 | 0.27 | | | | 0.50 | 0.09 | | | | 0.14 | | 0.00 |
| ML980082 | 0.63 | | | | 0.21 | | | | 0.08 | 0.08 | | 0.00 |
| ML980083 | 0.02 | 0.72 | | | 0.16 | 0.10 | | | | | | 0.00 |
| ML980084 | 0.67 | 0.06 | | | 0.27 | | | | | | | 0.00 |
| ML980085 | 0.30 | | | | 0.66 | 0.05 | | | | | | 0.10 |
| ML980086 | 0.45 | | | | 0.45 | 0.09 | | | | | | 0.00 |
| ML980087 | 0.35 | 0.04 | | | 0.61 | | | | | | | 0.00 |
| ML980088 | 0.38 | 0.05 | | | 0.57 | | | | | | | 0.00 |
| ML980089 | 0.47 | | | | 0.37 | 0.16 | | | | | | 0.00 |
| ML980090 | 0.43 | | | | 0.57 | | | | | | | 0.10 |
| ML980091 | 0.68 | | | | 0.27 | 0.05 | | | | | | 0.06 |
| ML980092 | 0.52 | | | | 0.46 | 0.02 | | | | | | 0.06 |

| Sample | Sedimentary | | | | Igneous Intrusive | | Igneous Extrusive | | Metamorphic | | Quartz | Mineral |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | sst/silt | lst | congl. | chert | granite | gabbro | rhyolite | basalt | skarn | hornfels | Pieces | |
| ML980093 | 0.40 | | | | 0.21 | 0.40 | | | | | | 0.00 |
| ML980094 | 0.65 | | | | 0.35 | | | | | | | 0.00 |
| ML980095 | 0.61 | | | 0.04 | 0.34 | 0.01 | | | | | | 0.00 |
| ML980096 | 0.60 | | | | 0.10 | | | | 0.06 | 0.24 | | 0.00 |
| ML980097 | 0.48 | | | | 0.50 | 0.02 | | | | | | 0.00 |
| ML980098 | 0.40 | | | | 0.58 | 0.02 | | | | | | 0.00 |
| ML980099 | 0.21 | | | | 0.55 | | | | | 0.25 | | 0.00 |
| ML980100 | 0.42 | | | | 0.52 | | | | 0.06 | | | 0.00 |
| ML980101 | 0.68 | | | | 0.25 | | | | 0.08 | | | 0.08 |
| ML980102 | 0.25 | | | 0.20 | 0.55 | | | | | | | 0.00 |
| ML980103 | 0.41 | | | 0.02 | 0.57 | | | | | | | 0.00 |
| ML980104 | 0.57 | | | | 0.41 | | | | | | 0.02 | 0.00 |
| ML980105 | 0.78 | | | | 0.22 | | | | | | | 0.00 |
| ML980106 | 0.80 | | | | 0.20 | | | | | | | 0.00 |
| ML980107 | 0.52 | | | | 0.22 | | | | 0.26 | | | 0.00 |
| ML980108 | 0.93 | | | | 0.07 | | | | | | | 0.00 |
| ML980109 | 1.00 | | | | | | | | | | | 0.00 |
| ML980110 | 0.53 | | | | 0.47 | | | | | | | 0.00 |
| MP990001 | 0.81 | | | | 0.19 | | | | | | | 0.00 |
| MP990002 | 0.43 | | | | 0.43 | 0.10 | | 0.03 | | | | 0.00 |
| MP990003 | 0.88 | | | | 0.07 | | 0.05 | | | | | 0.00 |
| MP990005 | 0.13 | | | 0.40 | 0.45 | | 0.01 | | | | | 0.00 |
| MP990006 | 0.09 | | | | 0.45 | | 0.45 | | | | | 0.00 |
| MP990007 | | | | | 0.02 | 0.01 | 0.97 | | | | | 0.00 |
| MP990008 | 0.48 | | | | 0.41 | 0.06 | | 0.05 | | | | 0.00 |
| MP990009 | | | | | 0.97 | 0.03 | | | | | | 0.00 |
| MP990010 | 0.30 | | | | 0.70 | | | | | | | 0.00 |
| MP990011 | 0.61 | | | 0.17 | 0.14 | | 0.04 | | | 0.04 | | 0.00 |
| MP990012 | 0.22 | | | | 0.35 | 0.23 | 0.21 | | | | | 0.00 |
| MP990013 | 0.04 | | | | 0.63 | 0.04 | 0.16 | 0.12 | | | | 0.00 |
| MP990014 | 0.03 | | 0.03 | 0.02 | 0.06 | 0.19 | 0.02 | 0.66 | | | | 0.00 |
| MP990016 | 0.55 | | | | 0.12 | 0.09 | | 0.23 | | | | 0.00 |
| MP990017 | 0.66 | | | | 0.11 | 0.02 | | 0.17 | | 0.04 | | 0.00 |
| MP990018 | 0.23 | | | 0.21 | 0.09 | 0.05 | 0.18 | 0.23 | | | | 0.00 |
| MP990019 | 0.14 | | | 0.07 | 0.53 | | | 0.26 | | | | 0.00 |
| MP990020 | | | | | 0.80 | | | 0.20 | | | | 0.00 |
| MP990021 | 0.74 | | | | | 0.26 | | | | | | 0.00 |
| MP990022 | 0.50 | | | | 0.17 | | 0.16 | 0.17 | | | | 0.00 |
| MP990023 | 0.29 | | | 0.18 | 0.40 | | | 0.11 | | 0.02 | | 0.00 |
| MP990024 | 0.07 | | | | 0.11 | | 0.54 | 0.25 | 0.04 | | | 0.00 |
| MP990025 | 0.83 | | | | 0.12 | 0.02 | 0.02 | | | | | 0.00 |
| MP990026 | 0.28 | | | | 0.50 | 0.12 | | 0.04 | | 0.06 | | 0.00 |
| MP990027 | 0.21 | | | | 0.13 | 0.02 | 0.04 | 0.58 | | | 0.02 | 0.00 |
| MP990028 | 0.08 | | | | 0.23 | 0.06 | | 0.60 | | 0.02 | | 0.00 |
| MP990029 | 0.04 | | | | 0.54 | 0.11 | 0.03 | 0.18 | | 0.10 | | 0.00 |
| MP990030 | 0.05 | | | | 0.06 | 0.01 | 0.49 | 0.36 | | 0.02 | | 0.00 |
| MP990031 | 0.03 | | | | 0.10 | 0.01 | 0.63 | 0.23 | | | | 0.00 |

| Sample | Sedimentary | | | | Igneous Intrusive | | Igneous Extrusive | | Metamorphic | | Quartz | Mineral |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | sst/silt | lst | congl. | chert | granite | gabbro | rhyolite | basalt | skarn | hornfels | Pieces | |
| MP990033 | 0.43 | | | | 0.09 | 0.18 | | 0.30 | | | | 0.00 |
| MP990034 | 0.13 | 0.05 | | | 0.08 | 0.03 | | 0.71 | | | | 0.00 |
| MP990035 | 0.35 | 0.43 | | | 0.12 | 0.01 | | 0.09 | | | | 0.00 |
| MP990036 | 0.15 | 0.78 | | | 0.07 | | | | | | | 0.00 |
| MP990037 | | | | | | | | | | | | 0.00 |
| MP990038 | 0.23 | | | | 0.40 | 0.08 | | 0.29 | | | | 0.00 |
| MP990039 | | | | | 0.05 | 0.03 | 0.47 | 0.45 | | | | 0.00 |
| MP990040 | | | | | 0.00 | | 0.43 | 0.57 | | | | 0.00 |
| MP990041 | | | | | 0.00 | | 1.00 | | | | | 0.00 |
| MP990042 | | | | 0.01 | 0.00 | 0.01 | 0.97 | | | | | 0.00 |
| MP990043 | 0.34 | | | | | 0.09 | 0.19 | 0.34 | | | 0.03 | 0.00 |
| MP990044 | 0.75 | | | | 0.01 | | 0.24 | | | | | 0.00 |
| MP990045 | 0.19 | | | | 0.00 | | 0.14 | 0.67 | | | | 0.00 |
| MP990046 | 0.28 | | | | 0.00 | 0.08 | 0.64 | | | | | 0.00 |
| MP990047 | 0.23 | | | | 0.00 | | 0.77 | | | | | 0.00 |
| MP990048 | | | | | 0.00 | | 1.00 | | | | | 0.00 |
| MP990049 | 0.61 | | | | | | 0.20 | 0.19 | | | | 0.00 |
| MP990050 | 0.42 | | | | 0.03 | | 0.27 | 0.29 | | | | 0.00 |
| MP990052 | 0.51 | | | | 0.03 | 0.44 | 0.03 | | | | | 0.00 |
| MP990053 | | | | 0.02 | 0.62 | | 0.23 | 0.13 | | | | 0.00 |
| MP990054 | | 0.07 | 0.10 | | | 0.07 | 0.76 | | | | | 0.00 |
| MP990055 | 0.16 | | | | 0.38 | 0.05 | 0.35 | 0.03 | | | 0.03 | 0.00 |
| MP990056 | 0.05 | | | | 0.71 | | | 0.17 | | 0.07 | | 0.00 |
| MP990060 | 0.47 | | | | 0.53 | | | | | | | 0.00 |
| MP990061 | 1.00 | | | | | | | | | | | 0.00 |
| MP990062 | | 0.31 | | | 0.14 | | | 0.42 | | 0.14 | | 0.14 |
| MP990063 | 0.76 | | | | 0.24 | | | | | | | 0.00 |
| MP990064 | 0.51 | 0.03 | | | 0.46 | | | | | | | 0.00 |
| MP990065 | 0.56 | 0.09 | | | 0.35 | | | | | | | 0.00 |
| MP990066 | | 0.02 | | | 0.95 | | 0.02 | 0.02 | | | | 0.00 |
| MP990067 | | 0.13 | | | 0.27 | | | 0.60 | | | | 0.00 |
| MP990068 | | | | | 0.38 | | | 0.63 | | | | 0.00 |

# APPENDIX IV

## GEOCHEMICAL ANALYSES

Geochemical analyses were performed on the silt+clay (-63$\mu$m) fraction of the till matrix samples, as well as the humus samples. Till matrix samples were kiln dried at 95°C and sieved in stainless steel sieves at the Department of Natural Resources and Energy sample preparation lab by R. Boldon and the author. Humus samples were air dried, sieved to -80 mesh (177$\mu$m).

Atomic Absorption Spectroscopy (AAS) analyses were performed for 12 elements (Ag, Cd, Co, Cu, Fe, Hg, Mn, Mo, Ni, Pb, V, and, Zn) at CANTECH Laboratories (Calgary, Alberta). Samples were digested in aqua regia. For determination of Ag, Cd, Co, Cu, Fe, Mn, Ni, Pb, and Zn, the digested samples were diluted with distilled/de-ionized water and analyzed using an air-acetylene flame. Molybdenum and vanadium were determined using a nitrous oxide acetylene flame after the digested samples were diluted with an Al (1250 ppm) solution. Mercury was determined using a modified Hatch and Ott procedure.

Instrumental Neutron Activation Analyses (INAA) were performed (34 elements - Ag, As, Au, Ba, Br, Cd, Ce, Co, Cr, Cs, Eu, Fe, Hf, Ir, La, Lu, Mo, Na, Ni, Rb, Sb, Sc, Se, Sm, Sn, Ta, Tb, Te, Th, U, W, Yb, Zn, and Zr) at Becquerel Laboratories Limited (Mississauga, Ontario). Samples were encapsulated and bundled together with neutron flux monitors in an irradiation container, and irradiated in a two-megawatt pool type reactor. After a one week decay period, samples were measured on a high-resolution germanium detector.

Seven elements (Ag, Cd, Co, Fe, Mo, Ni, and Zn) were determined by both AAS and INAA, however, AAS analysis has been deemed more suitable for determination of these elements (Fletcher, 1981; Hall, 1991) and therefore, only those results were used in data analysis.

Concentrations stated with a less than sign (<) indicate that the sample was below the instrumentation detection limit that specific element. For contouring and statistical analysis (Appendix VI) sample were given values equal to half the detection limit.

## APPENDIX IV-i: AAS Analysis - Till

| Sample Number | Ag ppm AAS | Cd ppm AAS | Co ppm AAS | Cu ppm AAS | Fe % AAS | Hg ppb AAS | Mn ppm AAS | Mo ppm AAS | Ni ppm AAS | Pb ppm AAS | V ppm AAS | Zn ppm AAS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TP870150 | 0.2 | <0.2 | 13 | 21 | 3.5 | 40 | 178 | 2 | 67 | 8 | 32 | 72 |
| TP870151 | <0.2 | <0.2 | 19 | 24 | 3.3 | 40 | 390 | 1 | 72 | 13 | 34 | 67 |
| TP870152 | <0.2 | <0.2 | 18 | 29 | 4.0 | 80 | 483 | <1 | 80 | 14 | 29 | 78 |
| TP870153 | <0.2 | <0.2 | 13 | 20 | 3.3 | 60 | 142 | 1 | 73 | 8 | 37 | 66 |
| TP870154 | <0.2 | <0.2 | 17 | 23 | 3.5 | 30 | 230 | 2 | 81 | 10 | 30 | 73 |
| TP870164 | <0.2 | <0.2 | 12 | 27 | 4.0 | 90 | 214 | 2 | 74 | 9 | 31 | 94 |
| TP870165 | <0.2 | <0.2 | 14 | 18 | 3.2 | 40 | 203 | <1 | 70 | 9 | 33 | 59 |
| TP870166 | <0.2 | <0.2 | 29 | 46 | 4.3 | 90 | 815 | 1 | 91 | 17 | 51 | 95 |
| TP870167 | <0.2 | <0.2 | 11 | 15 | 2.8 | 40 | 141 | 1 | 60 | 6 | 30 | 72 |
| TP870168 | <0.2 | 0.2 | 18 | 23 | 3.6 | 50 | 260 | 1 | 83 | 14 | 40 | 77 |
| TP870178 | <0.2 | <0.2 | 17 | 22 | 3.9 | 40 | 332 | 2 | 81 | 10 | 38 | 60 |
| TP870179 | 0.2 | <0.2 | 14 | 19 | 3.0 | 30 | 145 | <1 | 62 | 7 | 31 | 59 |
| TP870180 | <0.2 | 0.2 | 14 | 22 | 4.1 | 50 | 163 | 1 | 65 | 9 | 44 | 71 |
| TP870181 | 0.2 | <0.2 | 13 | 23 | 4.0 | 60 | 210 | 1 | 78 | 10 | 47 | 84 |
| TP870182 | <0.2 | 0.2 | 28 | 70 | 5.7 | 70 | 370 | 2 | 255 | 21 | 126 | 91 |
| TP870192 | <0.2 | 0.5 | 21 | 38 | 4.2 | 150 | 2380 | 1 | 79 | 8 | 68 | 108 |
| TP870193 | <0.2 | <0.2 | 15 | 35 | 3.9 | 70 | 154 | 1 | 54 | 7 | 60 | 56 |
| TP870194 | <0.2 | <0.2 | 18 | 29 | 3.9 | 90 | 505 | 1 | 88 | 13 | 40 | 65 |
| TP870195 | 1.1 | 0.2 | 14 | 59 | 3.4 | 120 | 180 | 2 | 60 | 16 | 62 | 72 |
| TP870196 | 0.2 | <0.2 | 12 | 31 | 2.5 | 80 | 112 | 1 | 49 | 11 | 50 | 55 |
| TP870206 | 0.2 | 0.2 | 41 | 72 | 6.6 | 90 | 1360 | 1 | 117 | 11 | 180 | 78 |
| TP870207 | <0.2 | <0.2 | 22 | 30 | 3.1 | 30 | 403 | <1 | 85 | 13 | 53 | 59 |
| TP870208 | 0.2 | 0.2 | 10 | 21 | 1.9 | 60 | 87 | 1 | 35 | 8 | 40 | 38 |
| TP870209 | 0.3 | 0.2 | 10 | 65 | 1.8 | 70 | 90 | 2 | 34 | 11 | 43 | 37 |
| TP870210 | 0.7 | 0.4 | 6 | 22 | 3.4 | 160 | 312 | 3 | 5 | 12 | 41 | 45 |
| TP870220 | 0.2 | <0.2 | 11 | 17 | 2.5 | 60 | 126 | <1 | 46 | 9 | 39 | 54 |
| TP870221 | <0.2 | <0.2 | 7 | 11 | 2.0 | 30 | 85 | 1 | 37 | 7 | 36 | 41 |
| TP870222 | <0.2 | 0.2 | 8 | 16 | 2.7 | 110 | 88 | 2 | 31 | 15 | 38 | 66 |
| TP870223 | <0.2 | <0.2 | 10 | 18 | 2.5 | 50 | 110 | 1 | 49 | 6 | 44 | 61 |
| TP870224 | 0.2 | 0.3 | 12 | 16 | 1.9 | 20 | 204 | <1 | 38 | 20 | 29 | 58 |
| TP870234 | 0.2 | <0.2 | 8 | 14 | 2.2 | 90 | 89 | 1 | 40 | 9 | 30 | 53 |
| TP870235 | <0.2 | <0.2 | 10 | 23 | 2.4 | 60 | 110 | 1 | 43 | 11 | 37 | 54 |
| TP870236 | 0.2 | <0.2 | 8 | 14 | 1.8 | 60 | 84 | 1 | 33 | 8 | 28 | 44 |
| TP870237 | <0.2 | <0.2 | 7 | 13 | 2.4 | 70 | 71 | 1 | 33 | 7 | 36 | 59 |
| TP870238 | 0.4 | 0.3 | 4 | 12 | 3.7 | 140 | 57 | 3 | 5 | 12 | 40 | 38 |
| TP870248 | 0.2 | 0.2 | 6 | 13 | 3.4 | 90 | 150 | 2 | 23 | 11 | 48 | 56 |
| TP870249 | 0.2 | <0.2 | 9 | 11 | 2.0 | 30 | 84 | 1 | 36 | 6 | 42 | 52 |
| TP870250 | <0.2 | 0.2 | 12 | 15 | 2.7 | 60 | 142 | <1 | 33 | 10 | 41 | 55 |
| TP870251 | 0.2 | <0.2 | 10 | 13 | 2.9 | 60 | 156 | 1 | 20 | 6 | 43 | 40 |
| TP870252 | 0.2 | <0.2 | 6 | 14 | 2.0 | 70 | 137 | <1 | 19 | 11 | 37 | 57 |
| TP850001 | <0.2 | 0.3 | 7 | 7 | 1.7 | 30 | 145 | 2 | 21 | 10 | 34 | 35 |
| TP850015 | <0.2 | 0.2 | 11 | 16 | 1.8 | 80 | 147 | 1 | 25 | 20 | 35 | 44 |
| TP850029 | <0.2 | 0.2 | 10 | 13 | 2 | 60 | 133 | 1 | 28 | 13 | 37 | 45 |
| TP850043 | <0.2 | <0.2 | 9 | 12 | 2.3 | 60 | 201 | <1 | 19 | 15 | 40 | 58 |
| TP850057 | 0.2 | 0.3 | 10 | 12 | 2 | 50 | 163 | 1 | 21 | 11 | 40 | 61 |

## APPENDIX IV-i: AAS Analysis - Till

| Sample Number | Ag ppm AAS | Cd ppm AAS | Co ppm AAS | Cu ppm AAS | Fe % AAS | Hg ppb AAS | Mn ppm AAS | Mo ppm AAS | Ni ppm AAS | Pb ppm AAS | V ppm AAS | Zn ppm AAS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TP850071 | <0.2 | 0.2 | 9 | 12 | 1.9 | 40 | 230 | 1 | 25 | 10 | 29 | 44 |
| TP850085 | 0.3 | 0.2 | 8 | 13 | 2 | 60 | 127 | 1 | 26 | 17 | 33 | 95 |
| TP850099 | 0.2 | 0.3 | 6 | 23 | 1.8 | 80 | 104 | <1 | 17 | 20 | 26 | 68 |
| TP850113 | <0.2 | 0.2 | 15 | 22 | 5 | 60 | 310 | 2 | 27 | 8 | 116 | 64 |
| 85LFA0513 | 0.2 | <0.2 | 13 | 10 | 1.7 | 90 | 390 | <1 | 22 | 8 | 70 | 44 |
| 85LFA0514 | <0.2 | <0.2 | 10 | 15 | 1.8 | 70 | 133 | 2 | 26 | 7 | 54 | 39 |
| 85LFA0515 | 0.2 | 0.4 | 8 | 19 | 1.9 | 80 | 375 | 1 | 23 | 16 | 38 | 145 |
| 85LFA0518 | 0.2 | 0.2 | 10 | 52 | 1.9 | 40 | 198 | <1 | 24 | 8 | 36 | 71 |
| 85LFA0550 | <0.2 | <0.2 | 19 | 31 | 3.5 | 70 | 575 | 1 | 75 | 15 | 40 | 63 |
| 85LFA0551 | 0.2 | <0.2 | 9 | 14 | 1.9 | 30 | 121 | 1 | 38 | 8 | 31 | 38 |
| 85LFA0555 | <0.2 | 0.2 | 9 | 13 | 1.6 | 50 | 184 | <1 | 27 | 13 | 28 | 42 |
| 85LFA0556 | 0.2 | 0.2 | 12 | 52 | 2.1 | 50 | 280 | 1 | 24 | 17 | 42 | 77 |
| 85LFA0557 | 0.3 | <0.2 | 16 | 20 | 2.8 | 40 | 145 | <1 | 30 | 17 | 47 | 74 |
| 85LFA0559 | 0.2 | <0.2 | 8 | 13 | 1.6 | 30 | 98 | <1 | 29 | 9 | 21 | 35 |
| 85LFA0560 | <0.2 | 0.2 | 10 | 20 | 2.3 | 80 | 90 | <1 | 43 | 12 | 36 | 49 |
| 87LFA2000 | <0.2 | 0.2 | 14 | 21 | 3.5 | 90 | 330 | 1 | 58 | 23 | 50 | 72 |
| 87LFA2001 | <0.2 | <0.2 | 15 | 20 | 2.8 | 30 | 274 | 1 | 56 | 16 | 54 | 63 |
| 87LFA2002 | 0.2 | <0.2 | 14 | 18 | 3.0 | 60 | 335 | 2 | 53 | 14 | 46 | 64 |
| 87LFA2004 | 0.2 | 0.2 | 16 | 35 | 2.9 | 40 | 368 | 2 | 63 | 34 | 59 | 74 |
| 87LFA2005 | <0.2 | 0.2 | 13 | 16 | 2.1 | 30 | 336 | 1 | 35 | 11 | 41 | 47 |
| 87LFA2006 | 0.2 | 0.2 | 14 | 18 | 2.5 | 40 | 270 | 3 | 52 | 15 | 44 | 46 |
| 87LFA2007 | 0.2 | <0.2 | 12 | 17 | 2.1 | 30 | 228 | 1 | 38 | 9 | 38 | 44 |
| 87LFA2008 | <0.2 | <0.2 | 10 | 16 | 1.7 | 30 | 213 | 1 | 28 | 8 | 38 | 41 |
| 87LFA2009 | 0.2 | 0.2 | 15 | 22 | 2.1 | 50 | 377 | <1 | 33 | 14 | 42 | 55 |
| 87LFA2010 | <0.2 | 0.2 | 8 | 14 | 1.8 | 40 | 162 | 1 | 27 | 9 | 37 | 52 |
| 87LFA2011 | <0.2 | <0.2 | 13 | 15 | 1.9 | 30 | 163 | 1 | 34 | 9 | 40 | 45 |
| 87LFA2012 | <0.2 | <0.2 | 8 | 12 | 1.5 | 30 | 96 | 2 | 24 | 8 | 33 | 36 |
| 87LFA2013 | 0.2 | <0.2 | 9 | 11 | 1.8 | 40 | 94 | 1 | 26 | 7 | 41 | 43 |
| 87LFA2014 | 0.2 | <0.2 | 9 | 11 | 1.4 | 40 | 120 | <1 | 23 | 9 | 36 | 42 |
| 87LFA2015 | <0.2 | <0.2 | 13 | 20 | 2.4 | 30 | 212 | <1 | 35 | 12 | 50 | 56 |
| 87LFA2016 | <0.2 | <0.2 | 10 | 17 | 1.8 | 30 | 230 | 1 | 28 | 7 | 45 | 48 |
| 87LFA2017 | 0.2 | <0.2 | 12 | 15 | 1.9 | 30 | 271 | <1 | 31 | 11 | 43 | 53 |
| 87LFA2018 | 0.2 | <0.2 | 13 | 15 | 1.6 | 30 | 285 | <1 | 25 | 8 | 40 | 45 |
| 87LFA2019 | 0.2 | <0.2 | 12 | 18 | 2.0 | 30 | 173 | 1 | 26 | 7 | 41 | 43 |
| 87LFA2020 | <0.2 | 0.2 | 9 | 16 | 1.6 | 70 | 109 | <1 | 24 | 10 | 36 | 43 |
| 87LFA2021 | 0.2 | <0.2 | 10 | 23 | 1.8 | 60 | 142 | 1 | 27 | 7 | 39 | 39 |
| 87LFA2022 | <0.2 | <0.2 | 12 | 33 | 2.2 | 30 | 310 | 1 | 33 | 12 | 44 | 63 |
| 87LFA2024 | <0.2 | 0.2 | 12 | 18 | 2.1 | 50 | 287 | 1 | 30 | 11 | 42 | 54 |
| 87LFA2025 | <0.2 | <0.2 | 11 | 19 | 2.5 | 40 | 266 | 1 | 28 | 16 | 52 | 65 |
| 87LFA2026 | 0.2 | 0.2 | 11 | 15 | 1.9 | 30 | 211 | 1 | 27 | 9 | 32 | 51 |
| 87LFA2027 | <0.2 | <0.2 | 13 | 18 | 2.0 | 30 | 404 | <1 | 33 | 8 | 34 | 49 |
| 87LFA2028 | 0.2 | <0.2 | 11 | 27 | 1.9 | 60 | 165 | <1 | 28 | 7 | 43 | 44 |
| 87LFA2029 | 0.2 | <0.2 | 13 | 17 | 2.3 | 70 | 213 | 1 | 40 | 11 | 44 | 54 |
| 87LFA2030 | <0.2 | 0.2 | 14 | 16 | 2.4 | 50 | 336 | 1 | 42 | 12 | 40 | 61 |
| 87LFA2031 | <0.2 | <0.2 | 12 | 20 | 2.1 | 30 | 300 | 1 | 36 | 8 | 47 | 48 |

## APPENDIX IV-i: AAS Analysis - Till

| Sample Number | Ag ppm AAS | Cd ppm AAS | Co ppm AAS | Cu ppm AAS | Fe % AAS | Hg ppb AAS | Mn ppm AAS | Mo ppm AAS | Ni ppm AAS | Pb ppm AAS | V ppm AAS | Zn ppm AAS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 87LFA2032 | <0.2 | <0.2 | 12 | 64 | 2.3 | 30 | 252 | <1 | 32 | 13 | 41 | 60 |
| 87LFA2033 | 0.2 | <0.2 | 20 | 26 | 2.8 | 60 | 364 | 1 | 65 | 14 | 33 | 62 |
| 87LFA2034 | <0.2 | <0.2 | 16 | 29 | 2.6 | 40 | 425 | <1 | 55 | 10 | 40 | 57 |
| 87LFA2035 | 0.2 | <0.2 | 14 | 26 | 2.5 | 70 | 287 | <1 | 51 | 12 | 48 | 51 |
| 87LFA2101 | <0.2 | <0.2 | 10 | 19 | 1.9 | 90 | 102 | 1 | 31 | 9 | 40 | 42 |
| 87LFA2107 | <0.2 | <0.2 | 11 | 20 | 2.1 | 60 | 92 | <1 | 33 | 7 | 44 | 41 |
| 87LFA2135 | <0.2 | 0.2 | 12 | 13 | 1.9 | 40 | 166 | 1 | 32 | 14 | 25 | 42 |
| 87LFA2136 | 0.2 | 0.2 | 11 | 19 | 2.0 | 50 | 120 | <1 | 33 | 15 | 30 | 55 |
| 87LFA2137 | 0.2 | 0.2 | 10 | 14 | 2.1 | 60 | 91 | <1 | 40 | 14 | 34 | 60 |
| 87LFA2138 | 0.2 | <0.2 | 10 | 13 | 2.0 | 80 | 89 | 1 | 35 | 9 | 32 | 40 |
| 87LFA2139 | 0.3 | <0.2 | 12 | 14 | 1.9 | 30 | 186 | <1 | 34 | 13 | 30 | 48 |
| 87LFA2143 | <0.2 | 0.2 | 13 | 17 | 2.4 | 60 | 190 | 1 | 37 | 12 | 40 | 57 |
| 87LFA2144 | <0.2 | <0.2 | 11 | 12 | 2.1 | 30 | 179 | <1 | 35 | 7 | 32 | 40 |
| 87LFA2145 | <0.2 | <0.2 | 13 | 19 | 3.3 | 80 | 232 | 2 | 42 | 11 | 58 | 77 |
| 87LFA2146 | 0.2 | 0.3 | 10 | 25 | 2.4 | 110 | 117 | 2 | 28 | 15 | 43 | 68 |
| 87LFA2201 | 0.2 | <0.2 | 15 | 22 | 2.3 | 50 | 380 | 2 | 41 | 16 | 50 | 49 |
| 87LFA2202 | <0.2 | 0.2 | 13 | 19 | 2.4 | 60 | 365 | <1 | 41 | 19 | 51 | 59 |
| 87LFA2205 | <0.2 | <0.2 | 19 | 25 | 3.0 | 30 | 379 | 1 | 69 | 15 | 50 | 64 |
| 87LFA2206 | <0.2 | 0.2 | 9 | 11 | 2.0 | 70 | 134 | 1 | 22 | 11 | 45 | 50 |
| 87LFA2207 | 0.2 | <0.2 | 13 | 17 | 2.3 | 60 | 301 | 1 | 34 | 15 | 53 | 51 |
| 87LFA2208 | 0.2 | <0.2 | 13 | 14 | 2.0 | 60 | 326 | 2 | 33 | 12 | 45 | 44 |
| 87LFA2237 | <0.2 | <0.2 | 9 | 13 | 1.8 | 40 | 340 | 1 | 27 | 8 | 30 | 54 |
| 87LFA2238 | <0.2 | 0.2 | 8 | 12 | 1.9 | 60 | 198 | <1 | 24 | 11 | 41 | 75 |
| 87LFA2242 | 0.3 | <0.2 | 11 | 13 | 1.7 | 40 | 184 | <1 | 27 | 8 | 43 | 41 |
| 87LFA2243 | <0.2 | <0.2 | 13 | 17 | 2.0 | 70 | 202 | 1 | 30 | 9 | 50 | 64 |
| 87LFA2244 | <0.2 | <0.2 | 11 | 14 | 1.9 | 60 | 390 | 1 | 26 | 8 | 52 | 44 |
| 87LFA2245 | 0.2 | <0.2 | 12 | 12 | 1.8 | 30 | 251 | <1 | 29 | 7 | 40 | 39 |
| 87LFA2246 | <0.2 | <0.2 | 11 | 15 | 1.7 | 50 | 398 | 1 | 27 | 7 | 43 | 45 |
| 87LFA3001-1 | <0.2 | 0.2 | 9 | 13 | 1.2 | 80 | 410 | 3 | 23 | 14 | 30 | 30 |
| 87LFA3003-1 | <0.2 | <0.2 | 34 | 37 | 10.8 | 100 | 1670 | 6 | 120 | 23 | 43 | 133 |
| 87LFA3004-1 | 0.2 | <0.2 | 10 | 16 | 2.2 | 40 | 403 | 3 | 29 | 21 | 37 | 84 |
| 87LFA3005-1 | <0.2 | <0.2 | 18 | 42 | 2.9 | 70 | 630 | 1 | 52 | 21 | 54 | 81 |
| 87LFA5159 | 0.2 | <0.2 | 15 | 17 | 3.0 | 40 | 341 | 1 | 41 | 9 | 55 | 50 |
| 87LFA5160 | <0.2 | <0.2 | 17 | 17 | 2.7 | 30 | 557 | <1 | 36 | 10 | 53 | 48 |
| 87LFA5388 | <0.2 | <0.2 | 17 | 18 | 2.3 | 40 | 340 | 1 | 50 | 16 | 49 | 61 |
| 87LFA5389 | 0.2 | 0.3 | 14 | 145 | 2.8 | 80 | 381 | 12 | 26 | 22 | 47 | 106 |
| 87LFA5390 | <0.2 | <0.2 | 21 | 24 | 3.0 | 30 | 503 | 1 | 65 | 18 | 42 | 61 |
| 87LFA5392 | <0.2 | <0.2 | 15 | 19 | 2.9 | 50 | 204 | 1 | 54 | 15 | 30 | 72 |
| 87LFA5393 | 0.2 | <0.2 | 25 | 31 | 3.9 | 50 | 645 | 1 | 86 | 15 | 44 | 85 |
| 87LFA5394 | <0.2 | 0.2 | 20 | 27 | 3.2 | 70 | 430 | <1 | 69 | 14 | 33 | 60 |
| 87LFA5395 | <0.2 | <0.2 | 10 | 16 | 2.7 | 50 | 188 | 1 | 54 | 8 | 31 | 58 |
| 87LFA5397 | <0.2 | <0.2 | 20 | 25 | 3.1 | 40 | 451 | 1 | 67 | 14 | 34 | 73 |
| 87LFA5398 | <0.2 | <0.2 | 25 | 30 | 4.0 | 50 | 607 | 2 | 89 | 16 | 38 | 81 |
| 87LFA5400 | <0.2 | <0.2 | 15 | 21 | 2.8 | 60 | 293 | <1 | 58 | 22 | 46 | 61 |
| 87LFA5401 | 0.2 | <0.2 | 17 | 23 | 2.7 | 60 | 285 | 1 | 63 | 16 | 48 | 60 |

## APPENDIX IV-i: AAS Analysis - Till

| Sample Number | Ag ppm AAS | Cd ppm AAS | Co ppm AAS | Cu ppm AAS | Fe % AAS | Hg ppb AAS | Mn ppm AAS | Mo ppm AAS | Ni ppm AAS | Pb ppm AAS | V ppm AAS | Zn ppm AAS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 87LFA5403 | 0.2 | <0.2 | 14 | 21 | 2.6 | 50 | 290 | 1 | 56 | 22 | 57 | 59 |
| 87LFA5404 | <0.2 | 0.2 | 13 | 16 | 3.2 | 60 | 425 | 2 | 54 | 12 | 50 | 79 |
| 87LFA5405 | 0.2 | 0.2 | 12 | 19 | 3.2 | 60 | 216 | 2 | 63 | 15 | 51 | 70 |
| 87LFA5406 | <0.2 | 0.2 | 27 | 36 | 3.1 | 30 | 550 | <1 | 84 | 30 | 60 | 80 |
| 87LFA5407 | 0.2 | 0.2 | 12 | 17 | 2.4 | 40 | 180 | 1 | 55 | 13 | 43 | 49 |
| 87LFA5408 | <0.2 | <0.2 | 21 | 33 | 3.4 | 60 | 1090 | 1 | 62 | 25 | 50 | 66 |
| 87LFA5409 | <0.2 | <0.2 | 20 | 20 | 2.6 | 60 | 603 | 1 | 49 | 18 | 31 | 59 |
| 87LFA5410 | <0.2 | 0.2 | 19 | 20 | 2.5 | 30 | 435 | <1 | 50 | 31 | 43 | 54 |
| 87LFA5411 | <0.2 | 0.3 | 20 | 30 | 4.1 | 100 | 1460 | 2 | 51 | 26 | 55 | 70 |
| 87LFA5417 | <0.2 | 0.2 | 13 | 29 | 2.9 | 60 | 325 | <1 | 30 | 15 | 53 | 76 |
| 87LFA5418 | 0.2 | 0.2 | 10 | 13 | 2.4 | 60 | 202 | 1 | 26 | 7 | 40 | 40 |
| 87LFA5419 | 0.2 | <0.2 | 9 | 45 | 2.6 | 80 | 136 | 4 | 21 | 10 | 42 | 60 |
| 87LFA5420 | 0.2 | <0.2 | 10 | 53 | 2.3 | 60 | 140 | 2 | 28 | 10 | 50 | 65 |
| 87LFA5421 | <0.2 | <0.2 | 12 | 23 | 2.1 | 30 | 240 | 2 | 30 | 7 | 35 | 45 |
| 87LFA5422 | <0.2 | <0.2 | 18 | 19 | 3.0 | 40 | 402 | 1 | 63 | 18 | 40 | 59 |
| 87LFA5423 | <0.2 | <0.2 | 11 | 17 | 2.5 | 30 | 163 | 2 | 44 | 12 | 41 | 46 |
| 87LFA5424 | <0.2 | 0.2 | 9 | 14 | 2.1 | 50 | 126 | 1 | 35 | 11 | 37 | 41 |
| 87LFA5425 | <0.2 | <0.2 | 13 | 18 | 2.3 | 30 | 710 | 1 | 40 | 25 | 36 | 72 |
| 87LFA5426 | <0.2 | <0.2 | 8 | 16 | 1.9 | 40 | 110 | 2 | 29 | 13 | 32 | 56 |
| 87LFA5427 | 0.2 | <0.2 | 10 | 37 | 2.2 | 30 | 134 | 2 | 30 | 9 | 54 | 48 |
| 87LFA5429 | <0.2 | <0.2 | 8 | 12 | 2.1 | 30 | 112 | <1 | 37 | 11 | 33 | 40 |
| 87LFA5430 | 0.2 | <0.2 | 12 | 13 | 2.4 | 40 | 160 | 1 | 45 | 10 | 38 | 55 |
| ML980001 | <0.2 | 0.3 | 8 | 25 | 2.0 | 80 | 112 | 2 | 48 | 18 | 32 | 107 |
| ML980002 | <0.2 | 0.6 | 8 | 53 | 2.6 | 100 | 210 | <1 | 67 | 49 | 51 | 220 |
| ML980003 | 0.2 | 0.3 | 13 | 119 | 3.3 | 100 | 162 | 1 | 57 | 46 | 45 | 271 |
| ML980004 | 0.2 | 0.2 | 9 | 44 | 2.9 | 70 | 137 | <1 | 86 | 34 | 53 | 154 |
| ML980005 | 0.2 | <0.2 | 11 | 20 | 3.1 | 20 | 110 | <1 | 56 | 13 | 40 | 55 |
| ML980006 | 0.4 | 0.2 | 11 | 30 | 2.3 | 60 | 173 | 1 | 59 | 11 | 52 | 48 |
| ML980007 | 0.3 | 0.2 | 7 | 23 | 3.4 | 80 | 151 | 2 | 72 | 10 | 74 | 67 |
| ML980008 | 0.2 | <0.2 | 4 | 46 | 4.3 | 100 | 68 | 6 | 40 | 36 | 77 | 143 |
| ML980009 | 1.0 | 0.3 | 12 | 284 | 3.1 | 90 | 143 | 1 | 15 | 14 | 80 | 35 |
| ML980010 | 0.7 | 0.3 | 9 | 58 | 2.9 | 70 | 196 | <1 | 87 | 42 | 51 | 157 |
| ML980011 | 0.4 | 0.9 | 9 | 229 | 5.4 | 70 | 240 | 1 | 54 | 44 | 46 | 326 |
| ML980012 | 0.2 | <0.2 | 10 | 72 | 2.9 | 90 | 106 | <1 | 66 | 40 | 43 | 347 |
| ML980013 | 0.3 | 0.2 | 12 | 28 | 2.6 | 70 | 114 | <1 | 65 | 21 | 38 | 65 |
| ML980014 | 0.4 | 0.2 | 17 | 29 | 2.4 | 80 | 372 | 1 | 66 | 25 | 40 | 60 |
| ML980015 | 0.3 | 0.3 | 11 | 25 | 5.5 | 80 | 155 | 2 | 69 | 14 | 82 | 94 |
| ML980016 | 0.5 | 0.5 | 11 | 27 | 4.0 | 120 | 180 | <1 | 71 | 12 | 75 | 57 |
| ML980017 | 0.5 | 0.2 | 9 | 78 | 2.9 | 90 | 98 | 2 | 87 | 60 | 39 | 296 |
| ML980018 | 0.9 | 0.3 | 7 | 27 | 2.4 | 60 | 154 | 2 | 55 | 21 | 32 | 104 |
| ML980019 | 0.8 | 0.8 | 12 | 39 | 2.6 | 80 | 219 | 1 | 33 | 14 | 50 | 234 |
| ML980020 | 1.5 | 0.6 | 14 | 75 | 2.7 | 60 | 183 | 4 | 59 | 28 | 53 | 313 |
| ML980021 | 0.9 | 0.4 | 8 | 39 | 3.1 | 100 | 110 | 1 | 79 | 133 | 48 | 105 |
| ML980022 | 2.2 | 1.0 | 9 | 23 | 2.3 | 80 | 537 | 4 | 48 | 20 | 36 | 96 |
| ML980023 | 0.8 | 0.7 | 8 | 64 | 4.4 | 140 | 113 | 3 | 34 | 35 | 59 | 266 |

## APPENDIX IV-i: AAS Analysis - Till

| Sample Number | Ag ppm AAS | Cd ppm AAS | Co ppm AAS | Cu ppm AAS | Fe % AAS | Hg ppb AAS | Mn ppm AAS | Mo ppm AAS | Ni ppm AAS | Pb ppm AAS | V ppm AAS | Zn ppm AAS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ML980024 | 0.3 | 0.4 | 10 | 29 | 3.1 | 80 | 161 | 2 | 53 | 20 | 43 | 127 |
| ML980025 | 0.5 | <0.2 | 12 | 42 | 2.8 | 40 | 378 | 2 | 66 | 21 | 40 | 63 |
| ML980026 | 0.4 | <0.2 | 9 | 28 | 2.6 | 100 | 130 | 1 | 92 | 75 | 47 | 132 |
| ML980027 | 1.0 | <0.2 | 12 | 20 | 2.3 | 50 | 192 | 1 | 45 | 24 | 49 | 72 |
| ML980028 | 0.6 | 0.2 | 11 | 24 | 3.7 | 70 | 174 | 2 | 71 | 10 | 75 | 53 |
| ML980029 | 0.5 | 0.3 | 15 | 62 | 2.9 | 60 | 240 | 1 | 60 | 34 | 56 | 232 |
| ML980030 | 2.0 | 0.3 | 11 | 71 | 3.0 | 60 | 133 | 1 | 79 | 28 | 68 | 221 |
| ML980031 | 2.6 | 0.3 | 11 | 26 | 2.7 | 100 | 141 | 1 | 76 | 17 | 47 | 156 |
| ML980032 | 1.7 | 0.4 | 9 | 58 | 2.8 | 100 | 150 | 1 | 86 | 42 | 53 | 139 |
| ML980033 | 0.2 | <0.2 | 10 | 15 | 4.3 | 100 | 155 | 1 | 51 | 11 | 34 | 125 |
| ML980034 | 0.8 | 0.3 | 9 | 30 | 2.2 | 60 | 132 | 1 | 58 | 25 | 36 | 90 |
| ML980035 | 0.3 | 0.2 | 15 | 26 | 2.3 | 70 | 227 | 3 | 69 | 24 | 43 | 169 |
| ML980036 | 1.3 | <0.2 | 15 | 37 | 3.0 | 70 | 145 | <1 | 89 | 23 | 60 | 120 |
| ML980037 | 0.5 | <0.2 | 12 | 260 | 3.6 | 50 | 230 | <1 | 70 | 81 | 54 | 93 |
| ML980038 | 0.6 | 0.2 | 13 | 53 | 2.5 | 60 | 164 | 1 | 76 | 17 | 45 | 82 |
| ML980039 | 0.4 | 0.2 | 18 | 104 | 2.7 | 40 | 336 | 1 | 101 | 27 | 42 | 76 |
| ML980040 | <0.2 | <0.2 | 22 | 25 | 3.9 | 50 | 510 | 1 | 98 | 26 | 97 | 112 |
| ML980041 | 0.2 | <0.2 | 15 | 28 | 4.0 | 70 | 241 | 5 | 101 | 20 | 32 | 84 |
| ML980042 | <0.2 | <0.2 | 30 | 41 | 3.6 | 60 | 776 | 1 | 82 | 16 | 62 | 73 |
| ML980043 | 0.4 | 0.2 | 8 | 51 | 5.4 | 50 | 123 | 2 | 182 | 12 | 106 | 60 |
| ML980044 | <0.2 | <0.2 | 8 | 26 | 2.7 | 60 | 120 | 1 | 57 | 14 | 31 | 101 |
| ML980045 | 0.2 | <0.2 | 9 | 28 | 2.4 | 20 | 162 | 2 | 55 | 10 | 40 | 59 |
| ML980046 | 0.2 | <0.2 | 13 | 46 | 2.4 | 20 | 214 | 1 | 57 | 10 | 44 | 62 |
| ML980047 | 0.5 | 0.2 | 10 | 55 | 2.6 | 40 | 160 | 3 | 68 | 19 | 50 | 53 |
| ML980048 | 0.3 | 0.2 | 9 | 26 | 3.5 | 100 | 128 | 3 | 47 | 18 | 76 | 52 |
| ML980049 | 0.4 | 0.3 | 10 | 112 | 3.2 | 60 | 112 | 2 | 53 | 12 | 43 | 92 |
| ML980050 | 0.5 | 0.2 | 11 | 75 | 2.7 | 60 | 217 | 2 | 49 | 13 | 39 | 83 |
| ML980051 | 0.6 | <0.2 | 9 | 39 | 4.0 | 110 | 190 | 6 | 66 | 3 | 89 | 79 |
| ML980052 | 0.2 | 0.3 | 19 | 66 | 4.4 | 150 | 165 | 20 | 41 | 4 | 62 | 58 |
| ML980053 | 0.4 | 0.2 | 11 | 277 | 3.7 | 60 | 157 | 1 | 83 | 100 | 80 | 92 |
| ML980054 | 3.1 | <0.2 | 10 | 45 | 3.9 | 100 | 176 | 4 | 66 | 23 | 87 | 87 |
| ML980055 | 0.2 | <0.2 | 12 | 71 | 5.0 | 70 | 113 | 3 | 50 | 8 | 130 | 107 |
| ML980056 | <0.2 | 0.2 | 11 | 67 | 2.2 | 50 | 104 | 2 | 52 | 18 | 54 | 49 |
| ML980057 | 0.4 | <0.2 | 11 | 21 | 2.3 | 60 | 139 | 1 | 52 | 14 | 32 | 54 |
| ML980058 | 0.7 | 0.3 | 10 | 20 | 3.0 | 90 | 180 | <1 | 67 | 16 | 50 | 86 |
| ML980059 | <0.2 | 0.2 | 8 | 30 | 4.0 | 130 | 73 | 1 | 54 | 17 | 62 | 94 |
| ML980060 | 0.2 | 0.2 | 9 | 16 | 1.9 | 60 | 78 | 2 | 40 | 10 | 34 | 52 |
| ML980061 | 0.2 | 0.3 | 4 | 17 | 2.1 | 70 | 64 | 2 | 45 | 10 | 38 | 55 |
| ML980062 | 0.2 | 0.2 | 8 | 8 | 1.0 | 50 | 76 | 1 | 20 | 12 | 22 | 42 |
| ML980063 | 0.2 | <0.2 | 10 | 13 | 2.1 | 60 | 163 | 14 | 39 | 10 | 31 | 69 |
| ML980064 | <0.2 | <0.2 | 11 | 114 | 4.3 | 90 | 120 | 5 | 55 | 2 | 93 | 40 |
| ML980065 | 0.2 | 0.3 | 13 | 96 | 2.4 | 60 | 117 | 55 | 52 | 12 | 50 | 46 |
| ML980066 | 0.2 | 0.2 | 12 | 630 | 4.3 | 100 | 104 | 6 | 60 | 28 | 72 | 59 |
| ML980067 | 0.9 | <0.2 | 3 | 179 | 2.6 | 110 | 210 | 2 | 65 | 40 | 68 | 74 |
| ML980068 | 0.3 | 0.2 | 3 | 125 | 3.4 | 90 | 77 | 7 | 18 | 5 | 54 | 26 |

## APPENDIX IV-i: AAS Analysis - Till

| Sample Number | Ag ppm AAS | Cd ppm AAS | Co ppm AAS | Cu ppm AAS | Fe % AAS | Hg ppb AAS | Mn ppm AAS | Mo ppm AAS | Ni ppm AAS | Pb ppm AAS | V ppm AAS | Zn ppm AAS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ML980069 | 0.2 | <0.2 | 13 | 39 | 2.0 | 100 | 121 | 20 | 9 | 6 | 51 | 25 |
| ML980070 | 0.2 | 0.3 | 12 | 287 | 3.1 | 140 | 150 | 4 | 78 | 2 | 92 | 40 |
| ML980071 | <0.2 | 0.2 | 18 | 194 | 2.1 | 70 | 236 | 27 | 30 | 7 | 49 | 37 |
| ML980072 | <0.2 | 0.4 | 12 | 304 | 3.3 | 60 | 124 | 22 | 67 | 15 | 86 | 68 |
| ML980073 | <0.2 | 0.3 | 10 | 395 | 2.8 | 60 | 93 | 2 | 46 | 21 | 70 | 49 |
| ML980074 | 0.2 | 0.4 | 9 | 111 | 2.1 | 80 | 110 | <1 | 46 | 20 | 47 | 44 |
| ML980075 | 0.2 | 0.3 | 13 | 36 | 2.2 | 60 | 307 | 6 | 49 | 12 | 40 | 47 |
| ML980076 | 0.4 | 0.2 | 9 | 347 | 2.8 | 60 | 114 | 2 | 32 | 15 | 54 | 45 |
| ML980077 | 0.3 | 0.3 | 10 | 118 | 2.7 | 110 | 108 | 30 | 52 | 16 | 51 | 61 |
| ML980078 | 0.3 | <0.2 | 7 | 347 | 2.9 | 110 | 90 | 12 | 53 | 14 | 50 | 49 |
| ML980079 | 0.2 | 0.2 | 11 | 214 | 5.0 | 90 | 102 | 5 | 39 | 7 | 99 | 23 |
| ML980080 | 0.2 | 1.9 | 9 | 191 | 2.3 | 80 | 420 | 2 | 48 | 14 | 52 | 41 |
| ML980081 | 0.2 | 0.2 | 10 | 276 | 2.2 | 70 | 108 | 8 | 39 | 18 | 52 | 40 |
| ML980082 | 1.0 | <0.2 | 9 | 41 | 6.1 | 140 | 185 | 5 | 57 | 11 | 60 | 82 |
| ML980083 | 0.2 | 0.2 | 5 | 28 | 2.1 | 100 | 90 | 1 | 26 | 9 | 44 | 45 |
| ML980084 | 1.4 | <0.2 | 6 | 53 | 2.6 | 140 | 121 | 2 | 27 | 13 | 51 | 37 |
| ML980085 | 0.8 | 0.3 | 10 | 120 | 3.7 | 80 | 134 | 8 | 53 | 17 | 57 | 62 |
| ML980086 | 0.2 | 0.2 | 11 | 435 | 3.0 | 40 | 127 | 9 | 48 | 6 | 75 | 39 |
| ML980087 | <0.2 | 0.2 | 9 | 116 | 2.4 | 60 | 98 | 5 | 47 | 11 | 40 | 38 |
| ML980088 | 1.3 | 0.3 | 9 | 213 | 2.6 | 110 | 110 | 4 | 43 | 17 | 63 | 59 |
| ML980089 | 0.4 | 0.2 | 10 | 97 | 1.9 | 60 | 93 | 2 | 44 | 11 | 29 | 34 |
| ML980090 | 0.4 | <0.2 | 9 | 92 | 2.6 | 90 | 106 | 5 | 48 | 10 | 42 | 45 |
| ML980091 | <0.2 | <0.2 | 8 | 66 | 2.5 | 100 | 110 | 4 | 49 | 9 | 44 | 54 |
| ML980092 | 0.3 | 0.2 | 15 | 240 | 2.7 | 100 | 144 | 7 | 53 | 18 | 40 | 54 |
| ML980093 | 0.2 | <0.2 | 14 | 48 | 2.7 | 60 | 180 | 2 | 60 | 20 | 47 | 65 |
| ML980094 | 0.5 | 0.3 | 12 | 107 | 3.2 | 70 | 103 | 6 | 66 | 12 | 73 | 61 |
| ML980095 | 0.2 | 0.2 | 10 | 54 | 2.8 | 60 | 96 | 5 | 50 | 11 | 48 | 35 |
| ML980096 | <0.2 | 0.2 | 12 | 127 | 3.2 | 90 | 112 | 10 | 67 | 13 | 66 | 44 |
| ML980097 | 0.2 | <0.2 | 11 | 93 | 3.0 | 70 | 125 | 4 | 62 | 11 | 54 | 49 |
| ML980098 | <0.2 | <0.2 | 12 | 180 | 2.7 | 90 | 109 | 9 | 49 | 12 | 69 | 35 |
| ML980099 | <0.2 | 0.2 | 8 | 45 | 2.3 | 40 | 77 | 2 | 40 | 8 | 40 | 35 |
| ML980100 | 0.2 | 0.2 | 10 | 69 | 2.9 | 100 | 142 | 4 | 51 | 9 | 58 | 73 |
| ML980101 | 0.5 | <0.2 | 12 | 78 | 4.1 | 70 | 156 | 4 | 72 | 12 | 80 | 61 |
| ML980102 | 0.4 | <0.2 | 10 | 76 | 2.6 | 90 | 97 | 2 | 48 | 11 | 43 | 45 |
| ML980103 | 1.2 | 0.5 | 6 | 55 | 3.9 | 130 | 123 | 3 | 29 | 9 | 61 | 39 |
| ML980104 | 0.2 | 0.3 | 10 | 54 | 3.6 | 80 | 110 | <1 | 53 | 13 | 52 | 38 |
| ML980105 | <0.2 | 0.3 | 10 | 47 | 2.4 | 80 | 119 | 1 | 55 | 11 | 49 | 43 |
| ML980106 | <0.2 | <0.2 | 12 | 57 | 2.3 | 30 | 132 | 1 | 54 | 10 | 54 | 42 |
| ML980107 | <0.2 | 0.2 | 74 | 14 | 1.3 | 30 | 64 | 1 | 18 | 6 | 36 | 28 |
| ML980108 | <0.2 | <0.2 | 12 | 21 | 3.7 | 60 | 120 | 2 | 76 | 14 | 38 | 61 |
| ML980109 | <0.2 | <0.2 | 16 | 24 | 3.6 | 40 | 285 | <1 | 85 | 13 | 39 | 76 |
| ML980110 | 0.5 | 0.4 | 19 | 24 | 5.7 | 120 | 263 | 4 | 46 | 18 | 200 | 100 |
| MP990001 | 0.2 | <0.2 | 13 | 21 | 4.8 | 80 | 121 | <1 | 46 | 7 | 48 | 96 |
| MP990002 | 0.4 | <0.2 | 10 | 13 | 4.0 | 70 | 113 | 1 | 38 | 8 | 45 | 77 |
| MP990003 | 0.2 | 0.2 | 31 | 47 | 4.6 | 100 | 920 | 1 | 114 | 45 | 73 | 160 |

## APPENDIX IV-i: AAS Analysis - Till

| Sample Number | Ag ppm AAS | Cd ppm AAS | Co ppm AAS | Cu ppm AAS | Fe % AAS | Hg ppb AAS | Mn ppm AAS | Mo ppm AAS | Ni ppm AAS | Pb ppm AAS | V ppm AAS | Zn ppm AAS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MP990005 | 0.3 | <0.2 | 10 | 15 | 3.6 | 100 | 131 | <1 | 43 | 15 | 52 | 75 |
| MP990006 | <0.2 | <0.2 | 7 | 12 | 1.8 | 40 | 63 | <1 | 31 | 6 | 26 | 41 |
| MP990007 | 0.2 | <0.2 | 7 | 11 | 1.9 | 70 | 98 | <1 | 26 | 12 | 30 | 45 |
| MP990008 | 0.2 | 0.2 | 11 | 17 | 2.6 | 60 | 164 | 1 | 32 | 7 | 39 | 54 |
| MP990009 | 0.2 | 0.5 | 14 | 21 | 3.6 | 70 | 160 | 1 | 59 | 19 | 50 | 150 |
| MP990010 | <0.2 | <0.2 | 8 | 11 | 1.9 | 30 | 86 | 1 | 34 | 9 | 26 | 41 |
| MP990011 | 0.2 | 0.2 | 9 | 13 | 3.7 | 90 | 159 | <1 | 31 | 17 | 43 | 72 |
| MP990012 | 0.2 | <0.2 | 11 | 15 | 2.3 | 60 | 133 | <1 | 25 | 8 | 35 | 39 |
| MP990013 | <0.2 | 0.2 | 8 | 11 | 2.0 | 60 | 99 | <1 | 24 | 10 | 27 | 65 |
| MP990014 | 0.3 | 0.2 | 8 | 14 | 4.1 | 130 | 192 | 2 | 24 | 10 | 35 | 58 |
| MP990016 | 0.2 | <0.2 | 19 | 25 | 3.4 | 60 | 296 | <1 | 71 | 15 | 42 | 78 |
| MP990017 | 0.3 | 0.2 | 10 | 14 | 4.7 | 130 | 143 | 1 | 37 | 10 | 49 | 47 |
| MP990018 | <0.2 | 0.2 | 14 | 18 | 2.6 | 70 | 131 | <1 | 50 | 16 | 38 | 56 |
| MP990019 | 0.2 | 0.2 | 8 | 20 | 2.7 | 100 | 153 | 1 | 24 | 9 | 32 | 63 |
| MP990020 | 1.0 | 0.5 | 6 | 16 | 3.6 | 140 | 309 | 2 | 8 | 11 | 37 | 55 |
| MP990021 | <0.2 | <0.2 | 12 | 14 | 3.0 | 50 | 221 | <1 | 59 | 7 | 39 | 54 |
| MP990022 | 0.2 | <0.2 | 16 | 23 | 3.6 | 80 | 328 | <1 | 64 | 14 | 48 | 69 |
| MP990023 | 0.2 | <0.2 | 9 | 17 | 4.5 | 70 | 174 | <1 | 42 | 18 | 45 | 116 |
| MP990024 | <0.2 | <0.2 | 11 | 21 | 2.9 | 60 | 299 | 1 | 37 | 14 | 47 | 50 |
| MP990025 | 0.2 | 0.2 | 9 | 12 | 1.9 | 30 | 193 | <1 | 46 | 10 | 34 | 45 |
| MP990026 | <0.2 | 0.2 | 13 | 18 | 3.2 | 60 | 176 | 1 | 47 | 9 | 43 | 49 |
| MP990027 | 0.2 | 0.3 | 10 | 20 | 3.0 | 100 | 175 | 1 | 25 | 7 | 40 | 73 |
| MP990028 | 0.2 | <0.2 | 13 | 23 | 2.8 | 60 | 168 | 2 | 36 | 5 | 59 | 56 |
| MP990029 | <0.2 | 0.2 | 10 | 22 | 2.7 | 60 | 205 | 1 | 25 | 8 | 45 | 57 |
| MP990030 | 0.2 | 0.3 | 6 | 12 | 1.6 | 60 | 64 | <1 | 22 | 14 | 30 | 80 |
| MP990031 | 0.2 | 0.4 | 4 | 8 | 2.5 | 170 | 234 | <1 | 10 | 7 | 64 | 56 |
| MP990033 | 0.2 | 0.2 | 10 | 14 | 3.6 | 60 | 197 | 2 | 37 | 8 | 37 | 82 |
| MP990034 | 0.2 | <0.2 | 13 | 22 | 3.2 | 50 | 132 | <1 | 39 | 8 | 45 | 47 |
| MP990035 | 0.3 | 0.2 | 16 | 18 | 3.0 | 60 | 361 | 1 | 33 | 9 | 62 | 53 |
| MP990036 | 0.3 | 0.2 | 14 | 12 | 3.0 | 20 | 170 | 1 | 40 | 10 | 47 | 46 |
| MP990037 | 0.2 | 0.5 | 7 | 12 | 3.4 | 140 | 221 | 2 | 11 | 20 | 37 | 53 |
| MP990038 | <0.2 | 0.2 | 11 | 15 | 2.5 | 60 | 458 | 3 | 37 | 10 | 36 | 69 |
| MP990039 | <0.2 | <0.2 | 15 | 19 | 2.9 | 40 | 394 | 1 | 49 | 11 | 48 | 64 |
| MP990040 | 0.2 | 0.2 | 9 | 22 | 4.1 | 60 | 145 | <1 | 28 | 10 | 54 | 53 |
| MP990041 | 0.3 | <0.2 | 9 | 11 | 2.2 | 30 | 138 | <1 | 26 | 9 | 35 | 42 |
| MP990042 | <0.2 | 0.3 | 7 | 13 | 2.3 | 100 | 115 | 1 | 23 | 11 | 32 | 139 |
| MP990043 | 0.2 | 0.2 | 14 | 15 | 3.1 | 30 | 509 | <1 | 46 | 14 | 43 | 47 |
| MP990044 | 0.2 | <0.2 | 14 | 30 | 5.0 | 70 | 262 | <1 | 73 | 16 | 50 | 76 |
| MP990045 | <0.2 | <0.2 | 12 | 16 | 3.3 | 80 | 193 | <1 | 31 | 8 | 52 | 73 |
| MP990046 | 0.2 | 0.2 | 12 | 19 | 2.6 | 70 | 180 | <1 | 32 | 11 | 48 | 50 |
| MP990047 | <0.2 | <0.2 | 11 | 18 | 3.1 | 80 | 252 | <1 | 34 | 13 | 47 | 53 |
| MP990048 | 0.2 | 0.4 | 8 | 13 | 1.8 | 70 | 361 | <1 | 23 | 17 | 29 | 228 |
| MP990049 | 0.2 | 0.2 | 10 | 14 | 2.3 | 80 | 176 | 1 | 24 | 11 | 45 | 53 |
| MP990050 | 0.2 | <0.2 | 8 | 13 | 2.5 | 60 | 122 | <1 | 43 | 7 | 38 | 71 |
| MP990052 | 0.2 | <0.2 | 9 | 17 | 2.5 | 80 | 156 | <1 | 37 | 10 | 40 | 45 |

## APPENDIX IV-i: AAS Analysis - Till

| Sample Number | Ag ppm AAS | Cd ppm AAS | Co ppm AAS | Cu ppm AAS | Fe % AAS | Hg ppb AAS | Mn ppm AAS | Mo ppm AAS | Ni ppm AAS | Pb ppm AAS | V ppm AAS | Zn ppm AAS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MP990053** | <0.2 | 0.2 | 12 | 13 | 2.3 | 30 | 381 | 1 | 34 | 7 | 43 | 46 |
| **MP990054** | <0.2 | 0.2 | 9 | 15 | 2.4 | 80 | 114 | <1 | 32 | 8 | 45 | 44 |
| **MP990055** | 0.2 | <0.2 | 13 | 21 | 2.8 | 60 | 213 | <1 | 29 | 13 | 53 | 39 |
| **MP990056** | 0.3 | 0.2 | 12 | 16 | 3.0 | 80 | 260 | 1 | 36 | 9 | 36 | 52 |
| **MP990060** | 0.3 | 0.2 | 6 | 14 | 3.5 | 80 | 128 | <1 | 31 | 9 | 34 | 105 |
| **MP990061** | 0.2 | <0.2 | 16 | 24 | 3.3 | 40 | 175 | 1 | 79 | 10 | 33 | 63 |
| **MP990062** | 0.3 | <0.2 | 27 | 91 | 5.5 | 80 | 583 | 2 | 99 | 9 | 134 | 68 |
| **MP990063** | 0.3 | 0.2 | 11 | 17 | 2.2 | 50 | 162 | <1 | 48 | 14 | 31 | 45 |
| **MP990064** | 0.4 | 0.2 | 10 | 19 | 4.9 | 130 | 139 | <1 | 52 | 11 | 36 | 78 |
| **MP990065** | 0.3 | 0.3 | 9 | 16 | 2.4 | 50 | 206 | 1 | 37 | 28 | 35 | 86 |
| **MP990066** | 0.2 | 0.3 | 9 | 15 | 2.1 | 50 | 121 | <1 | 22 | 17 | 30 | 62 |
| **MP990067** | 0.2 | 0.2 | 11 | 14 | 2.4 | 50 | 158 | <1 | 29 | 42 | 37 | 100 |
| **MP990068** | <0.2 | <0.2 | 8 | 19 | 2.5 | 80 | 124 | 1 | 25 | 8 | 29 | 37 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | As ppm INAA | Au ppb INAA | Ba ppm INAA | Br ppm INAA | Ce ppm INAA | Cr ppm INAA | Cs ppm INAA | Eu ppm INAA | Hf ppm INAA | Ir ppb INAA | La ppm INAA | Lu ppm INAA | Na % INAA | Rb ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TP870150 | 7.5 | <2 | 350 | 7.7 | 76 | 180 | 5.1 | <1 | 7 | <50 | 31 | <0.2 | 1.10 | 110 |
| TP870151 | 10.0 | 4 | 450 | 3.7 | 130 | 170 | 7.0 | 2 | 6 | <50 | 42 | 0.2 | 0.91 | 100 |
| TP870152 | 14.0 | 5 | 410 | 4.3 | 110 | 190 | 6.7 | 5 | 6 | <50 | 52 | 0.3 | 0.77 | 130 |
| TP870153 | 5.9 | <2 | 410 | 7.6 | 85 | 180 | 5.2 | 1 | 6 | <50 | 29 | <0.2 | 1.00 | 110 |
| TP870154 | 5.8 | <2 | 360 | 4.5 | 71 | 170 | 4.7 | 2 | 5 | <50 | 34 | <0.2 | 1.10 | 110 |
| TP870164 | 8.2 | 3 | 370 | 8.9 | 76 | 180 | 9.3 | 1 | 6 | <50 | 29 | <0.2 | 1.00 | 100 |
| TP870165 | 6.2 | <2 | 380 | 4.7 | 66 | 190 | 5.0 | 2 | 6 | <50 | 30 | 0.2 | 1.20 | 100 |
| TP870166 | 10.0 | <2 | 470 | 7.4 | 120 | 210 | 12.0 | 3 | 5 | <50 | 51 | 0.3 | 0.87 | 130 |
| TP870167 | 5.8 | <2 | 330 | 6.5 | 58 | 200 | 5.7 | 2 | 6 | <50 | 28 | <0.2 | 1.10 | 110 |
| TP870168 | 6.6 | 3 | 370 | 5.1 | 82 | 160 | 6.3 | <1 | 6 | <50 | 28 | <0.2 | 0.88 | 120 |
| TP870178 | 11.0 | <2 | 440 | 4.1 | 87 | 230 | 7.2 | 3 | 7 | <50 | 40 | <0.2 | 0.90 | 120 |
| TP870179 | 5.7 | <2 | 330 | 4.7 | 66 | 170 | 3.5 | 1 | 6 | <50 | 30 | <0.2 | 1.20 | 95 |
| TP870180 | 7.4 | <2 | 350 | 11.0 | 66 | 190 | 6.3 | <1 | 6 | <50 | 27 | <0.2 | 1.00 | 92 |
| TP870181 | 11.0 | <2 | 410 | 13.0 | 64 | 220 | 5.2 | 1 | 7 | <50 | 25 | <0.2 | 1.00 | 90 |
| TP870182 | 24.0 | <2 | 330 | 8.5 | 58 | 650 | 6.4 | <1 | 4 | <50 | 14 | <0.2 | 0.48 | 46 |
| TP870192 | 7.9 | <2 | 440 | 23.0 | 100 | 260 | 7.9 | 3 | 6 | <50 | 41 | 0.3 | 1.00 | 94 |
| TP870193 | 6.6 | <2 | 310 | 13.0 | 68 | 180 | 5.8 | <1 | 8 | <50 | 24 | <0.2 | 1.20 | 70 |
| TP870194 | 10.0 | 12 | 410 | 6.3 | 100 | 320 | 5.7 | 3 | 7 | <50 | 73 | 0.4 | 0.94 | 120 |
| TP870195 | 12.0 | 28 | 440 | 28.0 | 130 | 160 | 4.0 | 2 | 7 | <50 | 28 | <0.2 | 0.92 | 74 |
| TP870196 | 9.5 | <2 | 390 | 10.0 | 71 | 150 | 4.4 | 1 | 12 | <50 | 28 | <0.2 | 1.30 | 74 |
| TP870206 | 14.0 | <2 | 340 | 9.3 | 75 | 610 | 5.5 | 2 | 6 | <50 | 26 | <0.2 | 1.30 | 48 |
| TP870207 | 8.0 | 2 | 370 | 3.6 | 91 | 380 | 4.3 | 1 | 10 | <50 | 27 | <0.2 | 1.10 | 88 |
| TP870208 | 5.8 | <2 | 470 | 11.0 | 74 | 200 | 2.8 | 1 | 12 | <50 | 31 | <0.2 | 1.70 | 81 |
| TP870209 | 7.5 | 4 | 410 | 12.0 | 82 | 170 | 2.1 | 1 | 11 | <50 | 26 | <0.2 | 1.70 | 66 |
| TP870210 | 3.8 | <2 | 270 | 53.5 | 38 | 33 | 0.9 | <1 | 6 | <50 | 15 | <0.2 | 0.69 | 25 |
| TP870220 | 4.9 | 5 | 460 | 7.5 | 73 | 210 | 6.0 | 1 | 11 | <50 | 29 | <0.2 | 1.50 | 84 |
| TP870221 | 5.7 | 3 | 430 | 4.2 | 72 | 220 | 3.6 | <1 | 12 | <50 | 30 | <0.2 | 1.60 | 86 |
| TP870222 | 10.0 | 4 | 330 | 27.0 | 73 | 200 | 7.6 | <1 | 10 | <50 | 30 | <0.2 | 1.30 | 95 |
| TP870223 | 6.8 | 4 | 410 | 5.6 | 59 | 170 | 7.5 | 1 | 7 | <50 | 29 | <0.2 | 1.00 | 110 |
| TP870224 | 11.0 | 2 | 380 | 3.8 | 83 | 180 | 2.9 | 2 | 13 | <50 | 30 | <0.2 | 1.60 | 71 |
| TP870234 | 7.9 | <2 | 410 | 10.0 | 76 | 190 | 4.4 | 1 | 12 | <50 | 28 | <0.2 | 1.40 | 91 |
| TP870251 | 5.5 | <2 | 310 | 24.0 | 72 | 110 | 2.9 | 2 | 11 | <50 | 34 | <0.2 | 1.50 | 52 |
| TP870252 | 5.4 | <2 | 400 | 11.0 | 180 | 110 | 3.0 | 2 | 14 | <50 | 41 | <0.2 | 1.90 | 76 |
| TP850001 | 4.9 | <2 | 360 | 5.0 | 69 | 120 | 3.5 | <1 | 16 | <50 | 32 | 0.4 | 1.50 | 85 |
| TP850015 | 6.5 | 7 | 400 | 8.8 | 170 | 110 | 3.6 | <1 | 16 | <50 | 34 | 0.6 | 1.30 | 94 |
| TP850029 | 6.1 | 12 | 330 | 10.0 | 75 | 110 | 3.4 | 1 | 13 | <50 | 28 | 0.4 | 1.30 | 71 |
| TP850043 | 6.5 | 14 | 310 | 10.0 | 69 | 93 | 4.7 | <1 | 13 | <50 | 30 | 0.5 | 1.30 | 93 |
| TP850057 | 5.9 | 5 | 330 | 12.0 | 83 | 97 | 2.6 | 1 | 13 | <50 | 31 | 0.4 | 1.60 | 64 |
| TP850071 | 5.6 | 7 | 300 | 5.8 | 110 | 140 | 2.1 | 1 | 18 | <50 | 37 | 0.5 | 1.70 | 65 |
| TP850085 | 6.1 | 15 | 310 | 6.0 | 120 | 130 | 3.6 | <1 | 15 | <50 | 38 | 0.5 | 1.40 | 83 |
| TP850099 | 10.0 | <2 | 290 | 8.9 | 79 | 110 | 6.6 | <1 | 17 | <50 | 38 | 0.4 | 1.40 | 92 |
| TP850113 | 13.0 | 12 | 290 | 13.0 | 59 | 92 | 36.0 | <1 | 8 | <50 | 24 | 0.3 | 1.40 | 56 |
| 85LFA0513 | 11.0 | <2 | 420 | 13.0 | 93 | 110 | 2.4 | 3 | 12 | <50 | 38 | 0.2 | 1.80 | 57 |
| 85LFA0514 | 6.4 | <2 | 270 | 8.6 | 84 | 130 | 2.6 | 2 | 16 | <50 | 27 | <0.2 | 1.50 | 51 |
| 85LFA0515 | 5.7 | <2 | 330 | 6.8 | 260 | 140 | 3.1 | 3 | 16 | <50 | 79 | <0.2 | 1.50 | 68 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | As ppm INAA | Au ppb INAA | Ba ppm INAA | Br ppm INAA | Ce ppm INAA | Cr ppm INAA | Cs ppm INAA | Eu ppm INAA | Hf ppm INAA | Ir ppb INAA | La ppm INAA | Lu ppm INAA | Na % INAA | Rb ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 85LFA0518 | 4.8 | <2 | 370 | 8.1 | 84 | 130 | 1.9 | 2 | 16 | <50 | 29 | <0.2 | 1.70 | 66 |
| 85LFA0550 | 14.0 | <2 | 440 | 7.0 | 84 | 240 | 8.7 | 2 | 8 | <50 | 55 | 0.3 | 1.40 | 110 |
| 85LFA0551 | 5.0 | <2 | 430 | 1.9 | 79 | 210 | 2.2 | 2 | 15 | <50 | 35 | <0.2 | 1.80 | 71 |
| 85LFA0555 | 5.8 | <2 | 430 | 3.5 | 78 | 180 | 2.3 | 1 | 12 | <50 | 34 | <0.2 | 1.70 | 77 |
| 85LFA0556 | 7.2 | 4 | 430 | 8.8 | 87 | 110 | 2.6 | 1 | 10 | <50 | 32 | <0.2 | 1.40 | 63 |
| 85LFA0557 | 7.1 | <2 | 390 | 1.6 | 130 | 110 | 4.7 | 2 | 12 | <50 | 57 | 0.3 | 1.60 | 100 |
| 85LFA0559 | 6.5 | <2 | 360 | 5.4 | 85 | 160 | 2.3 | <1 | 13 | <50 | 30 | <0.2 | 1.60 | 75 |
| 85LFA0560 | 9.0 | <2 | 400 | 6.9 | 78 | 210 | 3.0 | 1 | 13 | <50 | 31 | <0.2 | 1.60 | 72 |
| 87LFA2000 | 14.0 | <2 | 390 | 11.0 | 67 | 230 | 4.5 | 2 | 7 | <50 | 28 | <0.2 | 1.20 | 91 |
| 87LFA2001 | 21.0 | <2 | 480 | 4.0 | 74 | 220 | 5.0 | 2 | 10 | <50 | 30 | <0.2 | 1.60 | 96 |
| 87LFA2002 | 12.0 | <2 | 410 | 7.1 | 140 | 240 | 5.7 | 2 | 11 | <50 | 30 | <0.2 | 1.30 | 86 |
| 87LFA2004 | 31.0 | <2 | 570 | 5.8 | 110 | 250 | 6.8 | 1 | 9 | <50 | 34 | <0.2 | 1.70 | 110 |
| 87LFA2005 | 6.0 | <2 | 410 | 6.3 | 77 | 160 | 4.0 | 2 | 9 | <50 | 27 | <0.2 | 1.90 | 68 |
| 87LFA2006 | 17.0 | <2 | 620 | 4.9 | 95 | 230 | 6.3 | 2 | 8 | <50 | 28 | <0.2 | 2.02 | 92 |
| 87LFA2007 | 7.5 | <2 | 380 | 5.0 | 90 | 180 | 2.2 | 1 | 15 | <50 | 34 | <0.2 | 1.70 | 74 |
| 87LFA2008 | 5.9 | <2 | 360 | 4.2 | 82 | 150 | 2.2 | 2 | 13 | <50 | 34 | <0.2 | 1.70 | 72 |
| 87LFA2009 | 7.6 | 3 | 380 | 4.0 | 97 | 160 | 2.5 | 2 | 13 | <50 | 35 | <0.2 | 1.40 | 72 |
| 87LFA2010 | 6.5 | <2 | 320 | 6.7 | 91 | 140 | 2.4 | 1 | 16 | <50 | 34 | 0.3 | 1.60 | 70 |
| 87LFA2011 | 6.1 | <2 | 320 | 7.4 | 80 | 160 | 2.1 | <1 | 15 | <50 | 31 | <0.2 | 1.60 | 65 |
| 87LFA2012 | 5.2 | <2 | 320 | 8.5 | 85 | 160 | 2.0 | 1 | 17 | <50 | 32 | <0.2 | 1.60 | 78 |
| 87LFA2013 | 4.2 | 4 | 380 | 5.8 | 59 | 120 | 2.9 | 1 | 15 | <50 | 28 | <0.2 | 1.30 | 65 |
| 87LFA2014 | 5.2 | <2 | 350 | 15.0 | 80 | 150 | 2.2 | <1 | 17 | <50 | 29 | <0.2 | 1.70 | 77 |
| 87LFA2015 | 7.8 | <2 | 360 | 10.0 | 86 | 130 | 3.2 | 2 | 11 | <50 | 31 | <0.2 | 1.30 | 78 |
| 87LFA2016 | 5.7 | <2 | 390 | 3.5 | 100 | 140 | 2.3 | 2 | 15 | <50 | 47 | 0.2 | 1.60 | 78 |
| 87LFA2017 | 7.0 | 3 | 310 | 5.8 | 77 | 150 | 2.0 | 2 | 13 | <50 | 30 | <0.2 | 1.50 | 67 |
| 87LFA2018 | 6.5 | <2 | 390 | 6.7 | 83 | 130 | 2.8 | 3 | 14 | <50 | 30 | <0.2 | 1.80 | 73 |
| 87LFA2019 | 6.6 | <2 | 410 | 6.2 | 84 | 130 | 2.5 | 2 | 12 | <50 | 30 | <0.2 | 1.70 | 73 |
| 87LFA2020 | 7.9 | <2 | 350 | 5.9 | 92 | 140 | 2.1 | 2 | 15 | <50 | 36 | <0.2 | 1.80 | 65 |
| 87LFA2021 | 6.1 | <2 | 310 | 8.9 | 93 | 140 | 3.7 | 2 | 16 | <50 | 29 | <0.2 | 1.60 | 61 |
| 87LFA2022 | 6.5 | <2 | 390 | 4.7 | 100 | 130 | 2.6 | <1 | 12 | <50 | 36 | <0.2 | 1.60 | 74 |
| 87LFA2024 | 7.2 | <2 | 370 | 8.8 | 120 | 150 | 2.4 | 2 | 15 | <50 | 33 | <0.2 | 1.60 | 73 |
| 87LFA2025 | 8.2 | 4 | 370 | 5.6 | 130 | 150 | 2.3 | 2 | 12 | <50 | 54 | 0.2 | 1.50 | 76 |
| 87LFA2026 | 5.3 | <2 | 390 | 5.2 | 99 | 130 | 2.7 | 2 | 14 | <50 | 36 | <0.2 | 1.60 | 61 |
| 87LFA2027 | 6.8 | <2 | 410 | 3.2 | 96 | 150 | 2.6 | 1 | 12 | <50 | 37 | <0.2 | 1.70 | 77 |
| 87LFA2028 | 7.3 | <2 | 340 | 10.0 | 110 | 130 | 2.2 | 1 | 15 | <50 | 32 | <0.2 | 1.70 | 54 |
| 87LFA2029 | 6.5 | <2 | 450 | 9.3 | 94 | 170 | 2.8 | 2 | 14 | <50 | 29 | <0.2 | 1.50 | 70 |
| 87LFA2030 | 11.0 | <2 | 470 | 13.0 | 84 | 180 | 2.8 | 1 | 11 | <50 | 30 | <0.2 | 1.50 | 80 |
| 87LFA2031 | 7.3 | <2 | 450 | 1.7 | 85 | 170 | 2.4 | 1 | 13 | <50 | 39 | <0.2 | 1.60 | 71 |
| 87LFA2032 | 8.8 | 6 | 390 | 4.0 | 100 | 160 | 2.7 | <1 | 13 | <50 | 46 | <0.2 | 1.50 | 81 |
| 87LFA2033 | 5.3 | <2 | 350 | 4.6 | 99 | 200 | 4.0 | <1 | 8 | <50 | 36 | <0.2 | 1.30 | 95 |
| 87LFA2034 | 5.6 | <2 | 340 | 4.7 | 88 | 190 | 2.9 | <1 | 8 | <50 | 28 | <0.2 | 1.40 | 77 |
| 87LFA2035 | 5.4 | 4 | 350 | 14.0 | 94 | 180 | 2.2 | <1 | 10 | <50 | 22 | <0.2 | 1.50 | 62 |
| 87LFA2101 | 6.2 | <2 | 350 | 7.6 | 94 | 170 | 2.1 | 2 | 16 | <50 | 35 | 0.2 | 1.70 | 67 |
| 87LFA2107 | 5.9 | 25 | 320 | 8.6 | 97 | 180 | 2.3 | 2 | 19 | <50 | 36 | 0.2 | 1.50 | 72 |
| 87LFA2135 | 7.7 | 3 | 330 | 3.5 | 95 | 180 | 2.3 | 1 | 12 | <50 | 29 | 0.3 | 1.80 | 63 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | As ppm INAA | Au ppb INAA | Ba ppm INAA | Br ppm INAA | Ce ppm INAA | Cr ppm INAA | Cs ppm INAA | Eu ppm INAA | Hf ppm INAA | Ir ppb INAA | La ppm INAA | Lu ppm INAA | Na % INAA | Rb ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **87LFA2136** | 10.0 | <2 | 310 | 10.0 | 81 | 140 | 2.6 | 2 | 9 | <50 | 33 | 0.2 | 1.60 | 75 |
| **87LFA2137** | 7.9 | <2 | 350 | 9.4 | 72 | 180 | 2.5 | 1 | 11 | <50 | 32 | 0.3 | 1.70 | 75 |
| **87LFA2138** | 7.3 | <2 | 340 | 9.2 | 82 | 180 | 2.2 | <1 | 12 | <50 | 33 | 0.3 | 1.70 | 59 |
| **87LFA2139** | 8.1 | <2 | 320 | 2.7 | 78 | 140 | 2.4 | 2 | 10 | <50 | 35 | 0.3 | 1.60 | 70 |
| **87LFA2143** | 7.2 | 3 | 330 | 8.1 | 74 | 170 | 2.7 | 1 | 10 | <50 | 29 | 0.3 | 1.50 | 72 |
| **87LFA2144** | 5.7 | <2 | 340 | 3.1 | 80 | 160 | 2.1 | 1 | 11 | <50 | 33 | 0.3 | 1.70 | 65 |
| **87LFA2145** | 8.2 | 3 | 330 | 19.0 | 74 | 160 | 3.2 | 2 | 8 | <50 | 29 | 0.3 | 1.20 | 72 |
| **87LFA2146** | 6.6 | <2 | 280 | 19.0 | 97 | 150 | 2.6 | 2 | 12 | <50 | 34 | 0.3 | 1.50 | 68 |
| **87LFA2201** | 12.0 | 5 | 520 | 3.8 | 83 | 160 | 3.5 | 2 | 8 | <50 | 38 | 0.2 | 1.80 | 80 |
| **87LFA2202** | 8.6 | 5 | 400 | 4.3 | 110 | 180 | 3.7 | 1 | 10 | <50 | 46 | 0.3 | 1.60 | 98 |
| **87LFA2205** | 9.5 | <2 | 360 | 2.3 | 85 | 200 | 4.6 | 2 | 6 | <50 | 35 | 0.2 | 1.30 | 97 |
| **87LFA2206** | 6.6 | <2 | 280 | 19.0 | 93 | 140 | 2.0 | 2 | 9 | <50 | 29 | 0.3 | 1.60 | 56 |
| **87LFA2207** | 7.9 | <2 | 370 | 5.9 | 150 | 150 | 2.6 | 2 | 9 | <50 | 59 | 0.3 | 1.80 | 75 |
| **87LFA2208** | 7.6 | <2 | 560 | 8.9 | 85 | 160 | 2.1 | 2 | 9 | <50 | 35 | <0.2 | 1.80 | 66 |
| **87LFA2237** | 6.4 | 2 | 320 | 3.2 | 160 | 130 | 2.1 | 2 | 13 | <50 | 66 | 0.3 | 1.80 | 77 |
| **87LFA2238** | 5.4 | <2 | 320 | 12.0 | 110 | 140 | 2.0 | 2 | 12 | <50 | 38 | 0.4 | 1.60 | 69 |
| **87LFA2242** | 11.0 | <2 | 330 | 10.0 | 110 | 140 | 3.3 | 2 | 13 | <50 | 35 | 0.4 | 1.80 | 61 |
| **87LFA2243** | 8.0 | <2 | 310 | 7.3 | 95 | 140 | 3.0 | <1 | 11 | <50 | 30 | 0.4 | 1.90 | 66 |
| **87LFA2244** | 7.1 | <2 | 290 | 7.2 | 83 | 130 | 2.9 | 1 | 11 | <50 | 32 | 0.3 | 1.90 | 56 |
| **87LFA2245** | 5.3 | <2 | 320 | 4.6 | 100 | 150 | 1.9 | 1 | 12 | <50 | 35 | 0.4 | 1.90 | 57 |
| **87LFA2246** | 7.8 | <2 | 370 | 3.1 | 110 | 140 | 3.0 | 3 | 12 | <50 | 48 | 0.5 | 1.80 | 69 |
| **87LFA3001-1** | 10.0 | 5 | 340 | 1.7 | 65 | 100 | 4.6 | 2 | 7 | <50 | 32 | 0.4 | 0.50 | 67 |
| **87LFA3003-1** | 7.2 | <2 | 300 | 3.7 | 100 | 200 | 5.8 | 4 | 4 | <50 | 49 | 0.3 | 0.21 | 110 |
| **87LFA3004-1** | 10.0 | <2 | 390 | 4.3 | 200 | 140 | 3.8 | 2 | 13 | <50 | 77 | 0.8 | 1.10 | 100 |
| **87LFA3005-1** | 13.0 | 9 | 430 | 1.6 | 89 | 160 | 5.8 | 2 | 6 | <50 | 41 | 0.3 | 1.30 | 99 |
| **87LFA5159** | 9.4 | <2 | 510 | 4.3 | 90 | 170 | 3.3 | <1 | 7 | <50 | 33 | 0.3 | 1.90 | 70 |
| **87LFA5160** | 11.0 | <2 | 400 | 3.7 | 100 | 170 | 2.7 | 2 | 7 | <50 | 32 | 0.3 | 2.00 | 68 |
| **87LFA5388** | 7.7 | <2 | 510 | 4.8 | 100 | 180 | 3.6 | 2 | 9 | <50 | 35 | 0.2 | 1.50 | 73 |
| **87LFA5389** | 26.0 | <2 | 510 | 13.0 | 120 | 93 | 12.0 | 2 | 10 | <50 | 47 | 0.4 | 1.90 | 160 |
| **87LFA5390** | 8.8 | 3 | 460 | 4.0 | 110 | 150 | 6.5 | 2 | 7 | <50 | 35 | <0.2 | 1.40 | 99 |
| **87LFA5392** | 7.9 | <2 | 310 | 7.4 | 78 | 170 | 3.9 | <1 | 6 | <50 | 30 | 0.2 | 1.20 | 88 |
| **87LFA5393** | 10.0 | <2 | 410 | 2.8 | 67 | 180 | 5.5 | 1 | 5 | <50 | 32 | 0.3 | 0.93 | 96 |
| **87LFA5394** | 7.1 | <2 | 460 | 4.1 | 110 | 180 | 6.8 | 2 | 5 | <50 | 42 | 0.3 | 0.86 | 120 |
| **87LFA5395** | 4.4 | <2 | 320 | 10.0 | 57 | 160 | 4.2 | <1 | 5 | <50 | 26 | <0.2 | 1.00 | 100 |
| **87LFA5397** | 7.2 | 2 | 350 | 3.2 | 77 | 170 | 5.4 | 1 | 5 | <50 | 34 | 0.2 | 1.30 | 96 |
| **87LFA5398** | 11.0 | <2 | 480 | 2.2 | 78 | 180 | 6.6 | 1 | 5 | <50 | 35 | 0.2 | 1.00 | 110 |
| **87LFA5400** | 10.0 | <2 | 480 | 5.8 | 94 | 200 | 3.5 | 2 | 7 | <50 | 33 | <0.2 | 1.30 | 84 |
| **87LFA5401** | 8.7 | <2 | 370 | 9.3 | 95 | 260 | 5.0 | <1 | 6 | <50 | 29 | <0.2 | 1.50 | 95 |
| **87LFA5403** | 10.0 | <2 | 480 | 5.6 | 98 | 190 | 3.7 | 1 | 7 | <50 | 33 | 0.2 | 1.40 | 95 |
| **87LFA5404** | 12.0 | <2 | 420 | 11.0 | 73 | 230 | 7.4 | <1 | 7 | <50 | 29 | 0.2 | 1.30 | 97 |
| **87LFA5405** | 15.0 | <2 | 420 | 13.0 | 98 | 220 | 5.9 | 1 | 8 | <50 | 33 | 0.3 | 1.70 | 82 |
| **87LFA5406** | 50.0 | <2 | 520 | 3.0 | 140 | 250 | 9.1 | 3 | 7 | <50 | 46 | 0.3 | 1.90 | 130 |
| **87LFA5407** | 25.0 | <2 | 400 | 10.0 | 120 | 250 | 5.4 | 1 | 8 | <50 | 32 | 0.2 | 1.90 | 81 |
| **87LFA5408** | 61.3 | <2 | 410 | 4.1 | 230 | 310 | 5.6 | 2 | 9 | <50 | 47 | 0.3 | 1.70 | 96 |
| **87LFA5409** | 20.0 | <2 | 430 | 3.7 | 120 | 220 | 4.3 | 3 | 8 | <50 | 54 | 0.5 | 1.70 | 95 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | As ppm INAA | Au ppb INAA | Ba ppm INAA | Br ppm INAA | Ce ppm INAA | Cr ppm INAA | Cs ppm INAA | Eu ppm INAA | Hf ppm INAA | Ir ppb INAA | La ppm INAA | Lu ppm INAA | Na % INAA | Rb ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 87LFA5410 | 40.0 | 4 | 520 | 3.1 | 160 | 230 | 4.9 | <1 | 7 | <50 | 39 | 0.3 | 1.80 | 110 |
| 87LFA5411 | 35.0 | 6 | 430 | 2.8 | 110 | 220 | 4.9 | 3 | 7 | <50 | 50 | 0.4 | 1.60 | 95 |
| 87LFA5417 | 8.0 | <2 | 270 | 7.4 | 99 | 150 | 3.2 | 1 | 10 | <50 | 31 | 0.2 | 1.30 | 78 |
| 87LFA5418 | 4.3 | <2 | 330 | 7.8 | 67 | 110 | 3.8 | 2 | 9 | <50 | 32 | 0.4 | 1.50 | 65 |
| 87LFA5419 | 10.0 | <2 | 380 | 17.0 | 82 | 110 | 2.3 | 1 | 9 | <50 | 36 | <0.2 | 1.60 | 65 |
| 87LFA5420 | 8.6 | <2 | 370 | 10.0 | 93 | 130 | 2.5 | 1 | 9 | <50 | 32 | 0.3 | 1.60 | 67 |
| 87LFA5421 | 6.0 | <2 | 320 | 5.2 | 84 | 130 | 1.8 | 2 | 12 | <50 | 33 | 0.3 | 1.80 | 69 |
| 87LFA5422 | 10.0 | <2 | 490 | 4.0 | 87 | 220 | 4.4 | <1 | 8 | <50 | 31 | <0.2 | 1.20 | 110 |
| 87LFA5423 | 8.3 | <2 | 410 | 4.1 | 78 | 190 | 3.1 | 1 | 10 | <50 | 29 | 0.3 | 1.70 | 72 |
| 87LFA5424 | 6.4 | <2 | 360 | 7.7 | 70 | 170 | 2.6 | <1 | 10 | <50 | 28 | 0.3 | 1.60 | 67 |
| 87LFA5425 | 14.0 | 3 | 430 | 0.9 | 81 | 180 | 3.0 | 1 | 10 | <50 | 39 | 0.3 | 1.60 | 86 |
| 87LFA5426 | 8.9 | <2 | 360 | 10.0 | 75 | 140 | 2.3 | 1 | 10 | <50 | 31 | 0.3 | 1.70 | 68 |
| 87LFA5427 | 7.5 | <2 | 340 | 7.4 | 96 | 130 | 2.4 | 2 | 9 | <50 | 34 | 0.3 | 1.60 | 60 |
| 87LFA5429 | 5.6 | <2 | 360 | 6.9 | 67 | 200 | 2.8 | 1 | 8 | <50 | 29 | 0.2 | 1.60 | 75 |
| 87LFA5430 | 1.7 | <2 | 88 | 1.8 | 16 | 44 | 0.8 | <1 | 2 | <50 | 6 | <0.2 | 0.33 | 19 |
| ML980001 | 13.0 | <2 | 380 | 10.0 | 48 | 210 | 2.5 | 1 | 8 | <50 | 25 | 0.3 | 1.30 | 65 |
| ML980002 | 26.0 | <2 | 470 | 16.0 | 71 | 250 | 3.1 | <1 | 7 | <50 | 26 | 0.3 | 1.10 | 71 |
| ML980003 | 11.0 | <2 | 450 | 24.0 | 70 | 210 | 2.4 | 2 | 9 | <50 | 28 | 0.4 | 1.20 | 68 |
| ML980004 | 16.0 | <2 | 410 | 13.0 | 70 | 320 | 3.1 | 1 | 10 | <50 | 30 | 0.4 | 1.40 | 64 |
| ML980005 | 15.0 | 2 | 370 | 6.7 | 56 | 320 | 2.7 | 2 | 9 | <50 | 29 | 0.4 | 1.50 | 70 |
| ML980006 | 12.0 | 3 | 400 | 11.0 | 84 | 230 | 3.8 | 2 | 12 | <50 | 35 | 0.5 | 1.70 | 65 |
| ML980007 | 10.0 | 4 | 300 | 32.0 | 71 | 210 | 5.6 | <1 | 7 | <50 | 30 | 0.3 | 1.00 | 57 |
| ML980008 | 6.9 | <2 | 320 | 76.9 | 68 | 200 | 4.5 | 2 | 5 | <50 | 32 | 0.5 | 0.39 | 31 |
| ML980009 | 3.7 | <2 | 360 | 35.0 | 64 | 63 | 1.6 | <1 | 6 | <50 | 38 | 0.2 | 1.90 | 19 |
| ML980010 | 19.0 | <2 | 380 | 16.0 | 77 | 310 | 2.7 | 1 | 7 | <50 | 28 | 0.3 | 1.20 | 70 |
| ML980011 | 14.0 | <2 | 410 | 14.0 | 44 | 200 | 2.4 | <1 | 8 | <50 | 23 | 0.2 | 1.00 | 65 |
| ML980012 | 11.0 | <2 | 450 | 13.0 | 78 | 210 | 2.2 | 1 | 8 | <50 | 28 | 0.3 | 1.20 | 69 |
| ML980013 | 14.0 | 2 | 330 | 9.4 | 60 | 420 | 2.2 | 1 | 11 | <50 | 29 | 0.4 | 1.50 | 61 |
| ML980014 | 14.0 | <2 | 460 | 11.0 | 69 | 250 | 2.6 | <1 | 11 | <50 | 31 | 0.5 | 1.60 | 64 |
| ML980015 | 11.0 | 4 | 280 | 25.0 | 65 | 230 | 5.3 | 1 | 6 | <50 | 35 | 0.5 | 1.00 | 77 |
| ML980016 | 13.0 | <2 | 270 | 38.0 | 87 | 230 | 5.0 | 1 | 6 | <50 | 32 | 0.4 | 0.62 | 51 |
| ML980017 | 20.0 | <2 | 440 | 9.5 | 86 | 340 | 2.8 | 1 | 7 | <50 | 29 | 0.3 | 1.10 | 60 |
| ML980018 | 15.0 | 2 | 360 | 12.0 | 62 | 320 | 2.2 | <1 | 12 | <50 | 32 | 0.5 | 1.60 | 72 |
| ML980019 | 11.0 | <2 | 430 | 18.0 | 55 | 220 | 3.1 | 2 | 10 | <50 | 29 | 0.4 | 1.30 | 78 |
| ML980020 | 10.0 | <2 | 410 | 15.0 | 65 | 280 | 2.0 | <1 | 12 | <50 | 31 | 0.4 | 1.50 | 61 |
| ML980021 | 23.0 | <2 | 340 | 13.0 | 93 | 240 | 2.8 | 1 | 7 | <50 | 25 | 0.3 | 1.10 | 69 |
| ML980022 | 14.0 | <2 | 360 | 11.0 | 56 | 260 | 2.6 | <1 | 11 | <50 | 29 | 0.3 | 1.50 | 64 |
| ML980023 | 10.0 | <2 | 320 | 35.0 | 44 | 250 | 2.8 | <1 | 5 | <50 | 20 | 0.2 | 0.77 | 49 |
| ML980024 | 10.0 | <2 | 330 | 18.0 | 54 | 310 | 2.6 | 2 | 7 | <50 | 28 | 0.3 | 1.30 | 65 |
| ML980025 | 16.0 | <2 | 350 | 7.9 | 66 | 340 | 3.2 | 1 | 8 | <50 | 29 | 0.4 | 1.40 | 68 |
| ML980026 | 42.0 | <2 | 410 | 25.0 | 170 | 250 | 4.2 | 2 | 7 | <50 | 43 | 0.5 | 1.30 | 60 |
| ML980027 | 21.0 | <2 | 400 | 7.7 | 76 | 260 | 3.0 | 1 | 13 | <50 | 34 | 0.5 | 1.60 | 75 |
| ML980028 | 29.0 | <2 | 320 | 37.0 | 98 | 240 | 5.1 | 1 | 7 | <50 | 34 | 0.5 | 0.83 | 68 |
| ML980029 | 14.0 | <2 | 460 | 10.0 | 69 | 280 | 3.1 | 1 | 8 | <50 | 29 | 0.3 | 1.40 | 80 |
| ML980030 | 12.0 | <2 | 400 | 14.0 | 52 | 340 | 2.9 | 1 | 8 | <50 | 26 | 0.3 | 1.40 | 56 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | As ppm INAA | Au ppb INAA | Ba ppm INAA | Br ppm INAA | Ce ppm INAA | Cr ppm INAA | Cs ppm INAA | Eu ppm INAA | Hf ppm INAA | Ir ppb INAA | La ppm INAA | Lu ppm INAA | Na % INAA | Rb ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ML980031 | 14.0 | <2 | 370 | 15.0 | 55 | 330 | 3.3 | <1 | 8 | <50 | 27 | 0.3 | 1.40 | 57 |
| ML980032 | 20.0 | 4 | 360 | 15.0 | 55 | 390 | 3.0 | 2 | 8 | <50 | 27 | 0.3 | 1.40 | 67 |
| ML980033 | 14.0 | <2 | 280 | 16.0 | 32 | 180 | 4.6 | <1 | 5 | <50 | 18 | 0.3 | 0.64 | 90 |
| ML980034 | 17.0 | <2 | 390 | 7.7 | 66 | 220 | 2.8 | <1 | 9 | <50 | 33 | 0.4 | 1.50 | 69 |
| ML980035 | 19.0 | <2 | 370 | 12.0 | 53 | 290 | 3.0 | 1 | 8 | <50 | 28 | 0.2 | 1.40 | 62 |
| ML980036 | 16.0 | <2 | 370 | 9.5 | 56 | 280 | 3.8 | 1 | 7 | <50 | 27 | 0.4 | 1.30 | 70 |
| ML980037 | 41.0 | 19 | 350 | 5.8 | 61 | 440 | 3.2 | <1 | 9 | <50 | 29 | 0.4 | 1.40 | 76 |
| ML980038 | 69.8 | 4 | 370 | 11.0 | 67 | 450 | 3.9 | 2 | 7 | <50 | 40 | 0.5 | 1.50 | 79 |
| ML980039 | 30.0 | <2 | 360 | 7.3 | 52 | 400 | 2.6 | 2 | 8 | <50 | 28 | 0.3 | 1.20 | 62 |
| ML980040 | 52.4 | 3 | 450 | 8.7 | 65 | 190 | 7.3 | 2 | 5 | <50 | 29 | 0.2 | 0.82 | 110 |
| ML980041 | 20.0 | <2 | 480 | 3.3 | 96 | 200 | 9.1 | 1 | 5 | <50 | 25 | 0.3 | 0.52 | 130 |
| ML980042 | 23.0 | <2 | 540 | 7.4 | 80 | 320 | 4.2 | 2 | 10 | <50 | 38 | 0.4 | 1.30 | 59 |
| ML980043 | 10.0 | <2 | 330 | 7.7 | 67 | 570 | 4.8 | 1 | 6 | <50 | 22 | 0.3 | 1.00 | 62 |
| ML980044 | 16.0 | <2 | 410 | 16.0 | 68 | 230 | 3.0 | <1 | 9 | <50 | 32 | 0.4 | 1.40 | 76 |
| ML980045 | 9.2 | <2 | 400 | 5.3 | 54 | 310 | 2.7 | 1 | 9 | <50 | 29 | 0.3 | 1.50 | 75 |
| ML980046 | 7.0 | <2 | 500 | 6.4 | 79 | 280 | 3.0 | 2 | 13 | <50 | 37 | 0.6 | 1.60 | 78 |
| ML980047 | 11.0 | <2 | 380 | 18.0 | 120 | 220 | 3.6 | 2 | 13 | <50 | 38 | 0.6 | 1.40 | 81 |
| ML980048 | 10.0 | <2 | 240 | 69.6 | 67 | 200 | 3.4 | 3 | 3 | <50 | 29 | 0.4 | 0.56 | 38 |
| ML980049 | 11.0 | <2 | 390 | 11.0 | 73 | 270 | 2.8 | <1 | 11 | <50 | 33 | 0.5 | 1.40 | 66 |
| ML980050 | 10.0 | 3 | 390 | 13.0 | 58 | 270 | 2.1 | <1 | 11 | <50 | 29 | 0.4 | 1.60 | 57 |
| ML980051 | 2.0 | <2 | 280 | 45.0 | 45 | 210 | 2.3 | <1 | 3 | <50 | 17 | 0.3 | 0.66 | 36 |
| ML980052 | 2.2 | <2 | 260 | 41.0 | 45 | 160 | 1.8 | 2 | 3 | <50 | 20 | 0.3 | 0.50 | 24 |
| ML980053 | 44.0 | 6 | 390 | 20.0 | 96 | 200 | 4.9 | 2 | 8 | <50 | 37 | 0.5 | 1.20 | 77 |
| ML980054 | 11.0 | <2 | 310 | 42.0 | 77 | 230 | 4.9 | 2 | 4 | <50 | 30 | 0.4 | 0.49 | 35 |
| ML980055 | 10.0 | <2 | 280 | 56.9 | 61 | 220 | 4.7 | 2 | 3 | <50 | 27 | 0.4 | 0.75 | 51 |
| ML980056 | 19.0 | 3 | 490 | 12.0 | 80 | 190 | 3.5 | 2 | 11 | <50 | 36 | 0.4 | 1.70 | 75 |
| ML980057 | 16.0 | <2 | 360 | 16.0 | 70 | 180 | 3.3 | 2 | 9 | <50 | 29 | 0.4 | 1.50 | 73 |
| ML980058 | 20.0 | <2 | 350 | 29.0 | 70 | 220 | 4.6 | 1 | 8 | <50 | 32 | 0.4 | 1.30 | 73 |
| ML980059 | 18.0 | <2 | 250 | 48.0 | 79 | 200 | 4.5 | 2 | 4 | <50 | 28 | 0.5 | 0.85 | 54 |
| ML980060 | 9.4 | <2 | 330 | 8.3 | 61 | 220 | 2.4 | 1 | 13 | <50 | 32 | 0.5 | 1.90 | 56 |
| ML980061 | 10.0 | 2 | 400 | 10.0 | 63 | 250 | 3.0 | <1 | 12 | <50 | 32 | 0.5 | 1.80 | 77 |
| ML980062 | 5.3 | <2 | 410 | 3.4 | 74 | 170 | 4.4 | 2 | 12 | <50 | 35 | 0.4 | 1.40 | 98 |
| ML980063 | 33.0 | <2 | 360 | 16.0 | 56 | 230 | 2.7 | 1 | 12 | <50 | 29 | 0.4 | 1.70 | 75 |
| ML980064 | 1.5 | 2 | 290 | 46.0 | 46 | 220 | 3.5 | <1 | 4 | <50 | 23 | 0.2 | 0.80 | 26 |
| ML980065 | 7.6 | <2 | 440 | 13.0 | 73 | 200 | 3.2 | 1 | 10 | <50 | 33 | 0.3 | 1.90 | 75 |
| ML980066 | 24.0 | <2 | 360 | 23.0 | 84 | 170 | 4.4 | 3 | 6 | <50 | 44 | 0.3 | 1.30 | 60 |
| ML980067 | 32.0 | 5 | 370 | 22.0 | 53 | 150 | 3.7 | 1 | 7 | <50 | 22 | 0.2 | 1.20 | 50 |
| ML980068 | 2.9 | <2 | 910 | 31.0 | 31 | 150 | 1.5 | 1 | 7 | <50 | 15 | 0.3 | 0.62 | 98 |
| ML980069 | 1.2 | <2 | 750 | 19.0 | 43 | 49 | 2.0 | <1 | 8 | <50 | 25 | 0.2 | 1.10 | 93 |
| ML980070 | 4.4 | <2 | 350 | 14.0 | 67 | 230 | 4.8 | 2 | 8 | <50 | 33 | 0.5 | 1.70 | 74 |
| ML980071 | 3.9 | <2 | 480 | 10.0 | 83 | 130 | 2.6 | 1 | 13 | <50 | 37 | 0.4 | 2.51 | 88 |
| ML980072 | 6.4 | <2 | 450 | 16.0 | 56 | 210 | 5.2 | 2 | 7 | <50 | 24 | 0.4 | 1.70 | 100 |
| ML980073 | 17.0 | 4 | 490 | 16.0 | 78 | 170 | 3.8 | 1 | 9 | <50 | 36 | 0.3 | 1.90 | 86 |
| ML980074 | 16.0 | 4 | 480 | 14.0 | 69 | 200 | 2.7 | <1 | 11 | <50 | 32 | 0.5 | 2.03 | 66 |
| ML980075 | 14.0 | 2 | 400 | 17.0 | 72 | 170 | 2.8 | <1 | 8 | <50 | 33 | 0.5 | 1.50 | 71 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | As ppm INAA | Au ppb INAA | Ba ppm INAA | Br ppm INAA | Ce ppm INAA | Cr ppm INAA | Cs ppm INAA | Eu ppm INAA | Hf ppm INAA | Ir ppb INAA | La ppm INAA | Lu ppm INAA | Na % INAA | Rb ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ML980076 | 28.0 | 3 | 500 | 19.0 | 100 | 130 | 4.9 | 2 | 7 | <50 | 44 | 0.6 | 1.30 | 100 |
| ML980077 | 11.0 | <2 | 430 | 15.0 | 62 | 200 | 3.1 | 1 | 9 | <50 | 31 | 0.3 | 1.50 | 78 |
| ML980078 | 7.2 | 3 | 430 | 14.0 | 62 | 140 | 3.8 | <1 | 8 | <50 | 29 | 0.3 | 1.40 | 79 |
| ML980079 | 3.6 | <2 | 450 | 32.0 | 45 | 160 | 4.0 | 1 | 6 | <50 | 24 | 0.3 | 1.20 | 67 |
| ML980080 | 7.3 | <2 | 380 | 22.0 | 68 | 170 | 3.5 | 2 | 8 | <50 | 29 | 0.4 | 1.50 | 67 |
| ML980081 | 11.0 | <2 | 430 | 16.0 | 66 | 150 | 2.6 | 3 | 9 | <50 | 30 | 0.4 | 1.70 | 74 |
| ML980082 | 16.0 | <2 | 350 | 33.0 | 48 | 240 | 2.7 | 2 | 4 | <50 | 23 | 0.3 | 0.64 | 40 |
| ML980083 | 2.2 | 3 | 1600 | 15.0 | 47 | 120 | 1.6 | 2 | 8 | <50 | 20 | 0.5 | 1.00 | 130 |
| ML980084 | 5.1 | <2 | 230 | 45.0 | 70 | 130 | 1.7 | <1 | 4 | <50 | 24 | 0.3 | 1.10 | 20 |
| ML980085 | 6.9 | <2 | 420 | 24.0 | 81 | 150 | 6.0 | 3 | 7 | <50 | 34 | 0.5 | 1.20 | 110 |
| ML980086 | 4.4 | <2 | 430 | 14.0 | 60 | 150 | 3.0 | 2 | 8 | <50 | 29 | 0.3 | 1.60 | 83 |
| ML980087 | 5.6 | <2 | 370 | 28.0 | 56 | 170 | 2.7 | 1 | 8 | <50 | 28 | 0.3 | 1.50 | 57 |
| ML980088 | 11.0 | <2 | 350 | 26.0 | 64 | 160 | 3.4 | 2 | 8 | <50 | 26 | 0.4 | 1.50 | 55 |
| ML980089 | 8.2 | <2 | 360 | 16.0 | 70 | 160 | 2.5 | 1 | 10 | <50 | 30 | 0.4 | 1.90 | 64 |
| ML980090 | 11.0 | <2 | 340 | 19.0 | 64 | 160 | 2.7 | 2 | 9 | <50 | 28 | 0.5 | 1.50 | 66 |
| ML980091 | 15.0 | <2 | 320 | 24.0 | 69 | 170 | 3.0 | 1 | 8 | <50 | 31 | 0.4 | 1.50 | 60 |
| ML980092 | 11.0 | <2 | 370 | 14.0 | 110 | 200 | 3.1 | 2 | 10 | <50 | 36 | 0.4 | 1.50 | 71 |
| ML980093 | 24.0 | <2 | 420 | 8.5 | 93 | 180 | 2.9 | 2 | 9 | <50 | 35 | 0.4 | 1.40 | 76 |
| ML980094 | 7.6 | <2 | 380 | 17.0 | 64 | 190 | 4.1 | <1 | 9 | <50 | 30 | 0.3 | 1.10 | 71 |
| ML980095 | 7.1 | <2 | 370 | 16.0 | 66 | 230 | 3.0 | 2 | 14 | <50 | 30 | 0.5 | 1.60 | 64 |
| ML980096 | 8.7 | <2 | 400 | 22.0 | 63 | 180 | 3.0 | 1 | 6 | <50 | 28 | 0.4 | 1.40 | 58 |
| ML980097 | 7.3 | <2 | 420 | 19.0 | 60 | 200 | 3.9 | 1 | 8 | <50 | 31 | 0.4 | 1.40 | 96 |
| ML980098 | 6.5 | 4 | 420 | 13.0 | 74 | 190 | 2.9 | 1 | 10 | <50 | 36 | 0.4 | 1.90 | 73 |
| ML980099 | 6.9 | <2 | 380 | 16.0 | 73 | 190 | 2.5 | <1 | 12 | <50 | 37 | 0.5 | 1.90 | 76 |
| ML980100 | 8.6 | <2 | 280 | 42.0 | 50 | 180 | 2.7 | 2 | 5 | <50 | 23 | 0.3 | 1.00 | 45 |
| ML980101 | 10.0 | <2 | 440 | 18.0 | 75 | 220 | 5.7 | 1 | 7 | <50 | 30 | 0.4 | 1.00 | 95 |
| ML980102 | 11.0 | <2 | 390 | 21.0 | 63 | 170 | 2.9 | 1 | 11 | <50 | 31 | 0.4 | 1.60 | 67 |
| ML980103 | 5.8 | <2 | 300 | 41.0 | 52 | 130 | 1.8 | 3 | 4 | <50 | 28 | <0.2 | 1.00 | 37 |
| ML980104 | 7.3 | <2 | 390 | 34.0 | 66 | 150 | 2.9 | 2 | 4 | <50 | 32 | 0.4 | 1.30 | 66 |
| ML980105 | 14.0 | 4 | 430 | 22.0 | 86 | 170 | 2.8 | 2 | 9 | <50 | 31 | 0.3 | 1.60 | 77 |
| ML980106 | 12.0 | 5 | 460 | 14.0 | 91 | 180 | 3.4 | <1 | 10 | <50 | 35 | 0.3 | 1.60 | 73 |
| ML980107 | 3.8 | <2 | 490 | 4.6 | 60 | 160 | 3.5 | <1 | 12 | <50 | 31 | 0.4 | 1.50 | 89 |
| ML980108 | 9.2 | 3 | 400 | 12.0 | 78 | 230 | 6.7 | 2 | 8 | <50 | 30 | 0.4 | 1.20 | 92 |
| ML980109 | 6.1 | <2 | 350 | 4.7 | 64 | 200 | 5.3 | <1 | 5 | <50 | 32 | 0.4 | 1.10 | 120 |
| ML980110 | 11.0 | <2 | 190 | 45.0 | 49 | 110 | 5.7 | 1 | 4 | <50 | 20 | 0.6 | 1.00 | 45 |
| MP990001 | 6.5 | <2 | 260 | 17.0 | 55 | 140 | 4.3 | <1 | 6 | <50 | 23 | 0.2 | 0.70 | 83 |
| MP990002 | 5.8 | <2 | 420 | 16.0 | 58 | 170 | 4.1 | <1 | 7 | <50 | 25 | 0.4 | 1.20 | 79 |
| MP990003 | 16.0 | 3 | 590 | 5.8 | 110 | 410 | 4.1 | 2 | 6 | <50 | 47 | 0.6 | 1.30 | 83 |
| MP990005 | 14.0 | <2 | 310 | 18.0 | 74 | 180 | 4.6 | 1 | 8 | <50 | 26 | 0.4 | 1.20 | 73 |
| MP990006 | 5.8 | <2 | 330 | 11.0 | 64 | 170 | 1.9 | <1 | 12 | <50 | 30 | 0.6 | 1.60 | 69 |
| MP990007 | 6.7 | 5 | 300 | 11.0 | 85 | 120 | 2.1 | <1 | 13 | <50 | 36 | 0.7 | 1.40 | 86 |
| MP990008 | 11.0 | <2 | 370 | 5.9 | 59 | 200 | 3.7 | 1 | 7 | <50 | 27 | 0.4 | 1.20 | 87 |
| MP990009 | 16.0 | <2 | 290 | 12.0 | 70 | 230 | 3.9 | 1 | 6 | <50 | 25 | 0.4 | 1.10 | 79 |
| MP990010 | 5.4 | <2 | 290 | 4.2 | 82 | 160 | 1.9 | 1 | 12 | <50 | 34 | 0.8 | 1.60 | 71 |
| MP990011 | 10.0 | <2 | 230 | 52.4 | 57 | 160 | 2.2 | 1 | 7 | <50 | 24 | 0.4 | 0.78 | 57 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | As ppm INAA | Au ppb INAA | Ba ppm INAA | Br ppm INAA | Ce ppm INAA | Cr ppm INAA | Cs ppm INAA | Eu ppm INAA | Hf ppm INAA | Ir ppb INAA | La ppm INAA | Lu ppm INAA | Na % INAA | Rb ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MP990012 | 5.6 | <2 | 310 | 17.0 | 110 | 120 | 2.4 | 1 | 11 | <50 | 38 | 0.6 | 1.50 | 62 |
| MP990013 | 5.6 | <2 | 300 | 20.0 | 90 | 130 | 2.3 | 1 | 13 | <50 | 32 | 0.6 | 1.60 | 73 |
| MP990014 | 16.0 | <2 | 220 | 40.0 | 53 | 66 | 4.8 | 2 | 4 | <50 | 26 | 0.4 | 1.10 | 48 |
| MP990016 | 11.0 | <2 | 310 | 6.4 | 68 | 240 | 4.7 | <1 | 6 | <50 | 28 | 0.4 | 1.00 | 93 |
| MP990017 | 11.0 | <2 | 240 | 31.0 | 56 | 140 | 4.6 | 2 | 7 | <50 | 22 | 0.4 | 0.84 | 63 |
| MP990018 | 9.0 | <2 | 350 | 18.0 | 64 | 190 | 3.0 | 1 | 9 | <50 | 26 | 0.5 | 1.20 | 80 |
| MP990019 | 7.4 | <2 | 300 | 41.0 | 72 | 110 | 2.0 | 2 | 9 | <50 | 32 | 0.3 | 1.20 | 66 |
| MP990020 | 2.5 | <2 | 110 | 56.8 | 83 | 23 | 0.8 | 2 | 4 | <50 | 32 | 0.4 | 0.47 | <5 |
| MP990021 | 4.7 | <2 | 370 | 12.0 | 71 | 210 | 3.5 | <1 | 7 | <50 | 26 | 0.4 | 1.40 | 89 |
| MP990022 | 10.0 | <2 | 290 | 15.0 | 130 | 190 | 4.7 | <1 | 5 | <50 | 27 | 0.3 | 1.00 | 93 |
| MP990023 | 11.0 | <2 | 290 | 16.0 | 65 | 140 | 6.7 | 1 | 6 | <50 | 21 | 0.5 | 0.66 | 140 |
| MP990024 | 16.0 | <2 | 320 | 12.0 | 87 | 190 | 4.4 | <1 | 8 | <50 | 22 | 0.4 | 1.30 | 71 |
| MP990025 | 9.2 | <2 | 510 | 5.5 | 82 | 250 | 3.5 | 2 | 11 | <50 | 31 | 0.5 | 2.00 | 84 |
| MP990026 | 6.4 | <2 | 380 | 15.0 | 120 | 150 | 4.0 | 1 | 8 | <50 | 31 | 0.4 | 1.20 | 83 |
| MP990027 | 4.5 | <2 | 330 | 20.0 | 63 | 120 | 2.1 | <1 | 7 | <50 | 29 | 0.3 | 1.20 | 60 |
| MP990028 | 6.9 | <2 | 330 | 16.0 | 59 | 130 | 1.8 | <1 | 10 | <50 | 27 | 0.5 | 1.50 | 50 |
| MP990029 | 8.5 | <2 | 310 | 11.0 | 74 | 140 | 4.0 | 2 | 10 | <50 | 31 | 0.6 | 1.40 | 72 |
| MP990030 | 4.5 | <2 | 300 | 12.0 | 87 | 130 | 2.2 | <1 | 11 | <50 | 35 | 0.4 | 1.60 | 66 |
| MP990031 | 4.8 | <2 | 180 | 53.4 | 25 | 91 | 1.7 | 2 | 4 | <50 | 11 | 0.3 | 0.58 | 13 |
| MP990033 | 6.9 | <2 | 280 | 14.0 | 49 | 170 | 5.5 | <1 | 6 | <50 | 23 | 0.3 | 1.00 | 83 |
| MP990034 | 10.0 | <2 | 320 | 16.0 | 92 | 180 | 2.7 | 1 | 8 | <50 | 26 | 0.4 | 1.40 | 53 |
| MP990035 | 6.7 | <2 | 420 | 11.0 | 97 | 160 | 3.9 | <1 | 7 | <50 | 31 | 0.4 | 1.60 | 80 |
| MP990036 | 5.2 | <2 | 360 | 9.5 | 87 | 150 | 2.7 | 2 | 9 | <50 | 32 | 0.5 | 1.50 | 70 |
| MP990037 | 8.2 | <2 | 120 | 41.0 | 150 | 41 | 1.1 | 1 | 7 | <50 | 23 | 0.5 | 0.54 | 34 |
| MP990038 | 5.3 | <2 | 480 | 19.0 | 140 | 160 | 3.6 | 3 | 12 | <50 | 43 | 1.0 | 1.50 | 80 |
| MP990039 | 9.2 | <2 | 340 | 8.9 | 63 | 160 | 3.7 | 1 | 8 | <50 | 25 | 0.4 | 1.10 | 74 |
| MP990040 | 8.5 | <2 | 310 | 16.0 | 86 | 150 | 2.9 | 3 | 12 | <50 | 37 | 0.9 | 1.20 | 68 |
| MP990041 | 4.7 | <2 | 290 | 7.4 | 83 | 140 | 2.3 | <1 | 13 | <50 | 34 | 0.6 | 1.50 | 63 |
| MP990042 | 5.0 | <2 | 310 | 23.0 | 91 | 120 | 2.7 | <1 | 16 | <50 | 35 | 0.7 | 1.40 | 62 |
| MP990043 | 10.0 | <2 | 320 | 14.0 | 110 | 190 | 3.2 | 1 | 9 | <50 | 27 | 0.7 | 0.22 | 94 |
| MP990044 | 17.0 | <2 | 350 | 27.0 | 110 | 190 | 6.2 | <1 | 5 | <50 | 23 | 0.3 | 0.87 | 98 |
| MP990045 | 7.4 | <2 | 350 | 26.0 | 57 | 150 | 2.6 | 2 | 9 | <50 | 30 | 0.4 | 1.20 | 65 |
| MP990046 | 6.3 | <2 | 320 | 14.0 | 160 | 140 | 2.5 | <1 | 12 | <50 | 39 | 0.6 | 1.50 | 68 |
| MP990047 | 6.2 | <2 | 320 | 16.0 | 230 | 200 | 3.1 | <1 | 12 | <50 | 90 | 0.9 | 1.20 | 68 |
| MP990048 | 4.9 | <2 | 240 | 8.8 | 300 | 170 | 2.0 | 3 | 22 | <50 | 69 | 0.9 | 1.40 | 69 |
| MP990049 | 19.0 | <2 | 230 | 25.0 | 56 | 110 | 3.7 | 1 | 9 | <50 | 23 | 0.4 | 1.40 | 48 |
| MP990050 | 6.1 | <2 | 320 | 16.0 | 57 | 190 | 5.7 | 2 | 7 | <50 | 27 | 0.5 | 1.20 | 100 |
| MP990052 | 8.8 | <2 | 390 | 17.0 | 94 | 170 | 3.5 | 1 | 9 | <50 | 29 | 0.5 | 1.50 | 81 |
| MP990053 | 4.7 | <2 | 370 | 1.8 | 75 | 150 | 2.5 | 2 | 12 | <50 | 37 | 0.7 | 1.60 | 63 |
| MP990054 | 6.7 | <2 | 310 | 10.0 | 81 | 150 | 2.3 | 1 | 13 | <50 | 30 | 0.6 | 1.50 | 64 |
| MP990055 | 6.1 | <2 | 280 | 19.0 | 180 | 150 | 1.7 | 1 | 10 | <50 | 33 | 0.6 | 1.70 | 65 |
| MP990056 | 8.0 | <2 | 290 | 26.0 | 79 | 150 | 2.3 | 2 | 12 | <50 | 29 | 0.6 | 1.20 | 53 |
| MP990060 | 8.8 | <2 | 350 | 13.0 | 53 | 140 | 3.5 | 1 | 9 | <50 | 27 | 0.4 | 1.40 | 70 |
| MP990061 | 6.7 | <2 | 310 | 3.7 | 66 | 190 | 5.2 | <1 | 5 | <50 | 33 | 0.3 | 1.30 | 100 |
| MP990062 | 7.2 | <2 | 330 | 16.0 | 95 | 310 | 7.7 | 1 | 5 | <50 | 19 | 0.3 | 1.30 | 61 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | As ppm INAA | Au ppb INAA | Ba ppm INAA | Br ppm INAA | Ce ppm INAA | Cr ppm INAA | Cs ppm INAA | Eu ppm INAA | Hf ppm INAA | Ir ppb INAA | La ppm INAA | Lu ppm INAA | Na % INAA | Rb ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MP990063** | 8.5 | <2 | 350 | 9.1 | 67 | 230 | 2.2 | <1 | 11 | <50 | 33 | 0.5 | 1.60 | 75 |
| **MP990064** | 9.3 | <2 | 270 | 21.0 | 46 | 200 | 4.8 | 1 | 5 | <50 | 25 | 0.4 | 0.93 | 69 |
| **MP990065** | 16.0 | <2 | 390 | 5.6 | 85 | 170 | 4.5 | 2 | 11 | <50 | 38 | 0.5 | 1.30 | 86 |
| **MP990066** | 7.4 | <2 | 300 | 11.0 | 73 | 140 | 2.3 | 1 | 13 | <50 | 33 | 0.5 | 1.70 | 63 |
| **MP990067** | 6.1 | <2 | 330 | 9.1 | 97 | 120 | 4.8 | <1 | 9 | <50 | 36 | 0.7 | 1.40 | 93 |
| **MP990068** | 5.0 | <2 | 270 | 14.0 | 89 | 110 | 3.2 | 2 | 11 | <50 | 35 | 0.5 | 1.60 | 53 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | Sb ppm INAA | Sc ppm INAA | Se ppm INAA | Sm ppm INAA | Sn ppm INAA | Ta ppm INAA | Tb ppm INAA | Te ppm INAA | Th ppm INAA | U ppm INAA | W ppm INAA | Yb ppm INAA | Zr ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TP870150 | 0.4 | 14.0 | <5 | 4.4 | <100 | 0.9 | 0.8 | <10 | 8.8 | 2.0 | <1 | 1 | <200 |
| TP870151 | 0.5 | 16.0 | <5 | 6.1 | <100 | 1.4 | 0.7 | <10 | 11.0 | 2.5 | 1 | 2 | <200 |
| TP870152 | 0.7 | 27.2 | <5 | 11.0 | <100 | 1.0 | 1.2 | <10 | 13.0 | 2.1 | 2 | 3 | <200 |
| TP870153 | 0.3 | 13.0 | <5 | 3.7 | <100 | 1.4 | <0.5 | <10 | 8.1 | 2.2 | 2 | 1 | <200 |
| TP870154 | 0.3 | 14.0 | <5 | 4.0 | <100 | 1.5 | 0.6 | <10 | 8.4 | 2.0 | <1 | 2 | <200 |
| TP870164 | 0.4 | 14.0 | <5 | 3.6 | <100 | 1.1 | 0.5 | <10 | 9.1 | 2.1 | <1 | 1 | 270 |
| TP870165 | 0.4 | 17.0 | <5 | 4.6 | <100 | 1.3 | 0.7 | <10 | 8.4 | 2.2 | 1 | 2 | <200 |
| TP870166 | 0.7 | 27.0 | <5 | 10.0 | <100 | 1.3 | 1.1 | <10 | 12.0 | 2.3 | 2 | 3 | 390 |
| TP870167 | 0.4 | 13.0 | <5 | 3.2 | <100 | 1.0 | <0.5 | <10 | 8.3 | 2.2 | <1 | 1 | <200 |
| TP870168 | 0.4 | 13.0 | <5 | 2.5 | <100 | 1.2 | <0.5 | <10 | 9.3 | 2.1 | <1 | 1 | <200 |
| TP870178 | 0.5 | 21.1 | <5 | 7.2 | <100 | 1.1 | 1.0 | <10 | 11.0 | 2.5 | 2 | 2 | <200 |
| TP870179 | 0.3 | 11.0 | <5 | 3.0 | <100 | 1.3 | <0.5 | <10 | 7.8 | 2.2 | <1 | 1 | <200 |
| TP870180 | 0.4 | 12.0 | <5 | 3.3 | <100 | 1.3 | <0.5 | <10 | 7.6 | 2.1 | <1 | 2 | 310 |
| TP870181 | 0.5 | 13.0 | <5 | 3.0 | <100 | 0.9 | <0.5 | <10 | 7.6 | 2.1 | <1 | 2 | 250 |
| TP870182 | 1.4 | 18.0 | <5 | 2.2 | <100 | 0.7 | <0.5 | <10 | 5.2 | 1.5 | <1 | <1 | <200 |
| TP870192 | 0.6 | 33.7 | <5 | 10.0 | <100 | 0.9 | 1.5 | <10 | 10.0 | 2.4 | <1 | 4 | 570 |
| TP870193 | 0.5 | 13.0 | <5 | 3.1 | <100 | 0.9 | <0.5 | <10 | 6.8 | 2.1 | 1 | 1 | <200 |
| TP870194 | 0.6 | 26.7 | <5 | 13.7 | <100 | 1.1 | 2.0 | <10 | 11.0 | 2.4 | <1 | 4 | <200 |
| TP870195 | 0.6 | 14.0 | <5 | 4.7 | <100 | 1.2 | 0.9 | <10 | 10.0 | 2.2 | 4 | 2 | 300 |
| TP870196 | 0.5 | 12.0 | <5 | 3.9 | <100 | 0.9 | 0.7 | <10 | 9.1 | 2.2 | <1 | 2 | 320 |
| TP870206 | 2.6 | 35.4 | <5 | 5.4 | <100 | 0.7 | 0.9 | <10 | 6.0 | 2.0 | 2 | 2 | <200 |
| TP870207 | 0.6 | 12.0 | <5 | 3.4 | <100 | 1.4 | <0.5 | <10 | 9.4 | 2.1 | <1 | 1 | 290 |
| TP870208 | 0.4 | 12.0 | <5 | 4.3 | <100 | 1.3 | <0.5 | <10 | 8.4 | 2.4 | 1 | 2 | 350 |
| TP870209 | 0.6 | 11.0 | <5 | 3.9 | <100 | 1.2 | 0.9 | <10 | 8.6 | 2.2 | 4 | 1 | 250 |
| TP870210 | 0.4 | 9.2 | <5 | 3.4 | <100 | 0.9 | <0.5 | <10 | 6.5 | 2.0 | 2 | 1 | <200 |
| TP870220 | 0.4 | 12.0 | <5 | 4.2 | <100 | 0.9 | 0.7 | <10 | 8.7 | 2.5 | <1 | 2 | 390 |
| TP870221 | 0.5 | 11.0 | <5 | 4.4 | <100 | 1.4 | 0.6 | <10 | 8.2 | 2.4 | <1 | 2 | 360 |
| TP870222 | 0.6 | 11.0 | <5 | 4.7 | <100 | 1.0 | <0.5 | <10 | 12.0 | 3.0 | 2 | 2 | 400 |
| TP870223 | 0.5 | 14.0 | <5 | 3.7 | <100 | 1.4 | 0.5 | <10 | 8.0 | 2.2 | 2 | 2 | <200 |
| TP870224 | 0.9 | 11.0 | <5 | 4.4 | <100 | 1.3 | 0.6 | <10 | 9.0 | 2.4 | <1 | 2 | 410 |
| TP870234 | 0.6 | 10.0 | <5 | 4.0 | <100 | 1.3 | <0.5 | <10 | 8.2 | 2.3 | 2 | 2 | 570 |
| TP870251 | 0.7 | 11.0 | <5 | 4.9 | <100 | 1.2 | <0.5 | <10 | 7.6 | 2.3 | <1 | 2 | 250 |
| TP870252 | 0.7 | 10.0 | <5 | 5.2 | <100 | 2.6 | 0.6 | <10 | 10.0 | 2.8 | <1 | 3 | 510 |
| TP850001 | 0.4 | 10.0 | <5 | 5.3 | <100 | 2.0 | 0.7 | <10 | 10.0 | 3.1 | 2 | 3 | 510 |
| TP850015 | 0.6 | 11.0 | <5 | 6.6 | <100 | 1.6 | 1.1 | <10 | 15.0 | 4.3 | <1 | 4 | 380 |
| TP850029 | 0.6 | 10.0 | <5 | 4.5 | <100 | 1.2 | 0.6 | <10 | 10.0 | 3.0 | 2 | 3 | 320 |
| TP850043 | 0.6 | 11.0 | <5 | 5.4 | <100 | 1.9 | 0.6 | <10 | 11.0 | 3.5 | <1 | 3 | 440 |
| TP850057 | 0.9 | 12.0 | <5 | 5.2 | <100 | 1.5 | 0.6 | <10 | 9.1 | 2.8 | <1 | 3 | 300 |
| TP850071 | 0.6 | 11.0 | <5 | 5.8 | <100 | 1.8 | 1.0 | <10 | 10.0 | 3.0 | <1 | 3 | 420 |
| TP850085 | 0.6 | 11.0 | <5 | 5.6 | <100 | 1.4 | 0.6 | <10 | 10.0 | 2.9 | 2 | 3 | 470 |
| TP850099 | 1.4 | 9.3 | <5 | 5.4 | <100 | 2.2 | 0.8 | <10 | 15.0 | 4.6 | 2 | 4 | 410 |
| TP850113 | 0.9 | 17.0 | <5 | 4.5 | <100 | 1.3 | 0.7 | <10 | 7.2 | 2.3 | <1 | 3 | <200 |
| 85LFA0513 | 0.5 | 23.5 | <5 | 7.3 | <100 | 1.5 | 1.3 | <10 | 8.6 | 2.8 | <1 | 3 | <200 |
| 85LFA0514 | 0.7 | 11.0 | <5 | 4.0 | <100 | 1.4 | 0.7 | <10 | 8.7 | 2.6 | <1 | 2 | 340 |
| 85LFA0515 | 0.8 | 11.0 | <5 | 10.5 | <100 | 1.6 | 1.1 | <10 | 8.7 | 2.9 | 1 | 2 | 290 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | Sb ppm INAA | Sc ppm INAA | Se ppm INAA | Sm ppm INAA | Sn ppm INAA | Ta ppm INAA | Tb ppm INAA | Te ppm INAA | Th ppm INAA | U ppm INAA | W ppm INAA | Yb ppm INAA | Zr ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **85LFA0518** | 0.5 | 11.0 | <5 | 4.5 | <100 | 1.5 | 0.7 | <10 | 8.6 | 2.4 | 2 | 2 | 570 |
| **85LFA0550** | 1.0 | 22.2 | <5 | 10.1 | <100 | 1.3 | 1.4 | <10 | 10.0 | 2.3 | <1 | 3 | 270 |
| **85LFA0551** | 0.5 | 11.0 | <5 | 5.3 | <100 | 1.6 | 0.7 | <10 | 9.3 | 2.7 | 1 | 3 | 360 |
| **85LFA0555** | 0.7 | 11.0 | <5 | 4.9 | <100 | 1.6 | 0.6 | <10 | 8.5 | 2.4 | 1 | 2 | 390 |
| **85LFA0556** | 0.9 | 12.0 | <5 | 4.4 | <100 | 1.5 | <0.5 | <10 | 8.6 | 2.2 | 2 | 2 | 340 |
| **85LFA0557** | 1.2 | 16.0 | <5 | 9.1 | <100 | 1.6 | 1.1 | <10 | 12.0 | 3.2 | <1 | 3 | 500 |
| **85LFA0559** | 0.5 | 10.0 | <5 | 4.2 | <100 | 1.4 | 0.6 | <10 | 9.4 | 2.5 | <1 | 2 | 420 |
| **85LFA0560** | 0.7 | 12.0 | <5 | 4.3 | <100 | 1.3 | 0.7 | <10 | 9.3 | 2.4 | 1 | 2 | 450 |
| **87LFA2000** | 1.0 | 15.0 | <5 | 4.0 | <100 | 1.4 | 0.7 | <10 | 8.3 | 2.2 | 1 | 2 | <200 |
| **87LFA2001** | 1.2 | 14.0 | <5 | 4.2 | <100 | 1.5 | 0.7 | <10 | 10.0 | 2.4 | <1 | 2 | 310 |
| **87LFA2002** | 1.4 | 14.0 | <5 | 4.7 | <100 | 1.5 | 1.0 | <10 | 10.0 | 2.3 | <1 | 3 | 390 |
| **87LFA2004** | 1.9 | 17.0 | <5 | 5.4 | <100 | 1.2 | 0.8 | <10 | 11.0 | 2.6 | <1 | 2 | 290 |
| **87LFA2005** | 0.7 | 11.0 | <5 | 3.7 | <100 | 1.3 | 0.6 | <10 | 8.4 | 2.1 | <1 | 2 | 310 |
| **87LFA2006** | 0.7 | 13.0 | <5 | 3.9 | <100 | 1.5 | 0.6 | <10 | 9.2 | 2.3 | <1 | 2 | <200 |
| **87LFA2007** | 0.7 | 11.0 | <5 | 5.0 | <100 | 1.2 | 0.7 | <10 | 10.0 | 2.7 | <1 | 3 | 490 |
| **87LFA2008** | 0.8 | 12.0 | <5 | 4.9 | <100 | 1.3 | 0.8 | <10 | 8.7 | 2.6 | <1 | 2 | 670 |
| **87LFA2009** | 1.0 | 14.0 | <5 | 5.0 | <100 | 1.3 | 0.6 | <10 | 9.4 | 2.6 | 2 | 2 | 380 |
| **87LFA2010** | 0.9 | 11.0 | <5 | 5.4 | <100 | 1.9 | 0.7 | <10 | 10.0 | 2.7 | <1 | 3 | 460 |
| **87LFA2011** | 0.6 | 13.0 | <5 | 4.4 | <100 | 1.5 | 0.7 | <10 | 10.0 | 2.9 | <1 | 3 | 600 |
| **87LFA2012** | 0.6 | 11.0 | <5 | 4.4 | <100 | 1.4 | 0.7 | <10 | 10.0 | 2.7 | <1 | 2 | 580 |
| **87LFA2013** | 0.5 | 10.0 | <5 | 4.1 | <100 | 1.7 | 0.6 | <10 | 9.0 | 2.7 | 1 | 2 | 580 |
| **87LFA2014** | 0.6 | 10.0 | <5 | 4.4 | <100 | 1.7 | 0.6 | <10 | 12.0 | 3.1 | 1 | 2 | 410 |
| **87LFA2015** | 0.8 | 13.0 | <5 | 4.8 | <100 | 1.6 | 0.8 | <10 | 10.0 | 2.4 | <1 | 2 | 360 |
| **87LFA2016** | 0.7 | 12.0 | <5 | 7.8 | <100 | 1.8 | 1.2 | <10 | 10.0 | 2.8 | 1 | 3 | 520 |
| **87LFA2017** | 0.8 | 11.0 | <5 | 4.2 | <100 | 1.4 | 0.6 | <10 | 8.8 | 2.4 | 1 | 3 | <200 |
| **87LFA2018** | 0.8 | 15.0 | <5 | 4.7 | <100 | 1.5 | 0.8 | <10 | 10.0 | 3.1 | <1 | 3 | 330 |
| **87LFA2019** | 0.6 | 11.0 | <5 | 4.6 | <100 | 1.5 | 0.8 | <10 | 8.5 | 2.3 | <1 | 2 | 390 |
| **87LFA2020** | 0.9 | 10.0 | <5 | 4.9 | <100 | 1.5 | 0.6 | <10 | 10.0 | 2.7 | <1 | 2 | 480 |
| **87LFA2021** | 0.7 | 13.0 | <5 | 4.4 | <100 | 1.1 | 0.5 | <10 | 8.3 | 2.5 | 1 | 3 | 500 |
| **87LFA2022** | 0.6 | 12.0 | <5 | 5.2 | <100 | 1.4 | 0.8 | <10 | 9.1 | 2.7 | <1 | 3 | 510 |
| **87LFA2024** | 0.7 | 11.0 | <5 | 5.2 | <100 | 1.4 | 0.7 | <10 | 10.0 | 2.7 | <1 | 3 | 540 |
| **87LFA2025** | 1.0 | 15.0 | <5 | 8.2 | <100 | 1.6 | 1.0 | <10 | 10.0 | 2.7 | <1 | 3 | 400 |
| **87LFA2026** | 0.6 | 11.0 | <5 | 5.4 | <100 | 1.6 | 0.7 | <10 | 9.0 | 2.8 | 2 | 3 | 270 |
| **87LFA2027** | 0.7 | 13.0 | <5 | 5.5 | <100 | 1.4 | <0.5 | <10 | 10.0 | 2.4 | <1 | 2 | 320 |
| **87LFA2028** | 0.8 | 14.0 | <5 | 5.0 | <100 | 1.4 | 0.9 | <10 | 8.4 | 2.4 | <1 | 2 | 450 |
| **87LFA2029** | 0.6 | 13.0 | <5 | 4.4 | <100 | 1.5 | 0.5 | <10 | 10.0 | 2.5 | <1 | 3 | 460 |
| **87LFA2030** | 0.7 | 13.0 | <5 | 4.7 | <100 | 1.1 | 0.8 | <10 | 9.1 | 2.2 | <1 | 2 | 390 |
| **87LFA2031** | 0.6 | 14.0 | <5 | 6.4 | <100 | 1.4 | 1.0 | <10 | 9.1 | 2.5 | <1 | 3 | 470 |
| **87LFA2032** | 0.9 | 13.0 | <5 | 6.9 | <100 | 1.4 | 0.8 | <10 | 10.0 | 2.8 | 2 | 3 | 320 |
| **87LFA2033** | 1.1 | 16.0 | <5 | 5.9 | <100 | 1.0 | 0.6 | <10 | 10.0 | 2.3 | 2 | 2 | 350 |
| **87LFA2034** | 0.5 | 13.0 | <5 | 3.7 | <100 | 0.8 | 0.6 | <10 | 8.7 | 2.0 | <1 | 2 | 370 |
| **87LFA2035** | 0.5 | 11.0 | <5 | 3.5 | <100 | 1.2 | 0.5 | <10 | 8.6 | 2.0 | <1 | 1 | 360 |
| **87LFA2101** | 0.6 | 11.0 | <5 | 4.8 | <100 | 1.2 | 0.7 | <10 | 10.0 | 2.7 | 1 | 3 | 400 |
| **87LFA2107** | 0.5 | 12.0 | <5 | 5.4 | <100 | 1.4 | 0.9 | <10 | 11.0 | 3.0 | 1 | 3 | 940 |
| **87LFA2135** | 0.7 | 10.0 | <5 | 4.2 | <100 | 1.5 | 0.6 | <10 | 9.0 | 2.6 | <1 | 2 | 680 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | Sb ppm INAA | Sc ppm INAA | Se ppm INAA | Sm ppm INAA | Sn ppm INAA | Ta ppm INAA | Tb ppm INAA | Te ppm INAA | Th ppm INAA | U ppm INAA | W ppm INAA | Yb ppm INAA | Zr ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 87LFA2136 | 1.0 | 10.0 | <5 | 4.6 | <100 | 1.0 | 0.9 | <10 | 10.0 | 2.7 | 1 | 2 | 640 |
| 87LFA2137 | 0.7 | 11.0 | <5 | 4.4 | <100 | 1.2 | <0.5 | <10 | 9.2 | 2.6 | 1 | 2 | 750 |
| 87LFA2138 | 0.7 | 11.0 | <5 | 4.6 | <100 | 1.3 | 0.7 | <10 | 9.2 | 2.6 | 1 | 3 | 520 |
| 87LFA2139 | 0.9 | 11.0 | <5 | 5.4 | <100 | 1.3 | 0.9 | <10 | 9.1 | 2.7 | 1 | 3 | 450 |
| 87LFA2143 | 0.7 | 12.0 | <5 | 4.3 | <100 | 1.2 | 0.9 | <10 | 8.6 | 2.5 | <1 | 2 | 420 |
| 87LFA2144 | 0.5 | 11.0 | <5 | 4.9 | <100 | 1.1 | 0.8 | <10 | 9.0 | 2.5 | 1 | 3 | 450 |
| 87LFA2145 | 0.7 | 15.0 | <5 | 5.2 | <100 | 0.9 | 0.9 | <10 | 7.8 | 2.1 | 1 | 2 | 440 |
| 87LFA2146 | 0.5 | 12.0 | <5 | 5.1 | <100 | 1.1 | 0.8 | <10 | 10.0 | 2.6 | 2 | 3 | 660 |
| 87LFA2201 | 1.1 | 15.0 | <5 | 6.6 | <100 | 1.2 | 1.0 | <10 | 8.6 | 2.3 | <1 | 3 | 720 |
| 87LFA2202 | 1.3 | 15.0 | <5 | 6.3 | <100 | 1.3 | 0.9 | <10 | 11.0 | 3.1 | 1 | 3 | 690 |
| 87LFA2205 | 0.8 | 16.0 | <5 | 5.3 | <100 | 1.1 | 0.8 | <10 | 8.9 | 2.2 | 2 | 2 | <200 |
| 87LFA2206 | 1.0 | 11.0 | <5 | 4.6 | <100 | 1.2 | 0.8 | <10 | 11.0 | 2.9 | <1 | 3 | 760 |
| 87LFA2207 | 1.2 | 15.0 | <5 | 10.0 | <100 | 1.3 | 1.6 | <10 | 11.0 | 3.2 | <1 | 3 | 480 |
| 87LFA2208 | 1.1 | 13.0 | <5 | 5.8 | <100 | 1.1 | 1.0 | <10 | 8.4 | 4.8 | <1 | 3 | 500 |
| 87LFA2237 | 0.7 | 11.0 | <5 | 10.0 | <100 | 1.4 | 1.2 | <10 | 10.0 | 3.0 | <1 | 3 | 800 |
| 87LFA2238 | 0.8 | 11.0 | <5 | 6.3 | <100 | 1.5 | 1.0 | <10 | 10.0 | 2.7 | <1 | 3 | 610 |
| 87LFA2242 | 1.1 | 13.0 | <5 | 5.7 | <100 | 1.1 | 1.1 | <10 | 9.0 | 2.7 | 1 | 3 | 720 |
| 87LFA2243 | 1.0 | 15.0 | <5 | 4.3 | <100 | 1.2 | 0.9 | <10 | 9.2 | 2.7 | <1 | 3 | 590 |
| 87LFA2244 | 1.1 | 14.0 | <5 | 4.8 | <100 | 1.2 | 1.0 | <10 | 9.0 | 2.8 | 1 | 3 | 600 |
| 87LFA2245 | 0.6 | 11.0 | <5 | 5.3 | <100 | 1.4 | 1.0 | <10 | 8.8 | 2.5 | <1 | 3 | 620 |
| 87LFA2246 | 0.8 | 17.0 | <5 | 7.3 | <100 | 1.4 | 1.3 | <10 | 9.5 | 2.8 | <1 | 4 | 550 |
| 87LFA3001-1 | 1.0 | 12.0 | <5 | 4.8 | <100 | 0.8 | 1.0 | <10 | 8.5 | 2.0 | 1 | 3 | 560 |
| 87LFA3003-1 | 1.1 | 29.1 | <5 | 9.1 | <100 | 0.9 | 1.7 | <10 | 9.3 | 2.3 | 2 | 4 | <200 |
| 87LFA3004-1 | 1.4 | 15.0 | <5 | 12.6 | <100 | 2.0 | 1.6 | <10 | 16.0 | 4.1 | <1 | 5 | 710 |
| 87LFA3005-1 | 1.5 | 19.0 | <5 | 6.6 | <100 | 1.1 | 1.1 | <10 | 9.3 | 2.4 | 1 | 3 | <200 |
| 87LFA5159 | 1.0 | 18.0 | <5 | 4.9 | <100 | 1.2 | 0.5 | <10 | 8.4 | 2.3 | <1 | 2 | 420 |
| 87LFA5160 | 1.3 | 14.0 | <5 | 4.3 | <100 | 1.2 | 0.7 | <10 | 8.1 | 2.0 | 1 | 2 | 400 |
| 87LFA5388 | 0.9 | 14.0 | <5 | 4.5 | <100 | 1.2 | 0.7 | <10 | 10.0 | 2.7 | <1 | 2 | 450 |
| 87LFA5389 | 0.8 | 14.0 | <5 | 7.1 | <100 | 1.8 | 0.9 | <10 | 18.0 | 5.5 | 5 | 4 | 590 |
| 87LFA5390 | 0.7 | 13.0 | <5 | 5.7 | <100 | 1.1 | 0.9 | <10 | 10.0 | 2.2 | <1 | 2 | 450 |
| 87LFA5392 | 0.6 | 12.0 | <5 | 4.8 | <100 | 1.0 | 0.7 | <10 | 8.2 | 2.1 | 1 | 2 | 350 |
| 87LFA5393 | 0.8 | 17.0 | <5 | 5.6 | <100 | 0.9 | 0.9 | <10 | 8.7 | 2.0 | <1 | 2 | <200 |
| 87LFA5394 | 0.5 | 18.0 | <5 | 7.5 | <100 | 1.1 | 1.0 | <10 | 10.0 | 2.3 | <1 | 2 | <200 |
| 87LFA5395 | 0.5 | 13.0 | <5 | 3.7 | <100 | 1.1 | <0.5 | <10 | 8.4 | 2.2 | 1 | 2 | 360 |
| 87LFA5397 | 0.7 | 16.0 | <5 | 4.7 | <100 | 1.1 | 0.8 | <10 | 9.5 | 2.2 | 1 | 2 | <200 |
| 87LFA5398 | 0.8 | 19.0 | <5 | 6.1 | <100 | 1.1 | 1.2 | <10 | 10.0 | 2.1 | 2 | 2 | <200 |
| 87LFA5400 | 1.1 | 15.0 | <5 | 4.3 | <100 | 1.2 | 0.6 | <10 | 10.0 | 2.4 | 1 | 2 | 530 |
| 87LFA5401 | 1.1 | 14.0 | <5 | 3.9 | <100 | 1.3 | 0.6 | <10 | 9.0 | 2.2 | 1 | 2 | 350 |
| 87LFA5403 | 1.1 | 15.0 | <5 | 4.2 | <100 | 1.1 | 0.6 | <10 | 10.0 | 2.6 | <1 | 2 | 440 |
| 87LFA5404 | 0.7 | 15.0 | <5 | 3.8 | <100 | 1.0 | 0.6 | <10 | 9.2 | 2.4 | 1 | 2 | <200 |
| 87LFA5405 | 0.7 | 14.0 | <5 | 5.0 | <100 | 1.0 | 0.8 | <10 | 8.4 | 2.4 | <1 | 2 | 490 |
| 87LFA5406 | 1.6 | 19.0 | <5 | 6.8 | <100 | 0.9 | 0.8 | <10 | 10.0 | 2.5 | 1 | 3 | 490 |
| 87LFA5407 | 1.0 | 13.0 | <5 | 4.6 | <100 | 1.1 | 0.8 | <10 | 8.2 | 2.3 | <1 | 2 | 380 |
| 87LFA5408 | 2.3 | 20.0 | <5 | 6.4 | <100 | 0.7 | 1.1 | <10 | 14.0 | 2.6 | 1 | 3 | 340 |
| 87LFA5409 | 1.6 | 17.0 | <5 | 10.8 | <100 | 1.1 | 1.8 | <10 | 11.0 | 2.6 | <1 | 4 | 430 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | Sb ppm INAA | Sc ppm INAA | Se ppm INAA | Sm ppm INAA | Sn ppm INAA | Ta ppm INAA | Tb ppm INAA | Te ppm INAA | Th ppm INAA | U ppm INAA | W ppm INAA | Yb ppm INAA | Zr ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 87LFA5410 | 1.5 | 17.0 | <5 | 5.4 | <100 | 1.2 | 0.6 | <10 | 11.0 | 2.6 | 2 | 2 | 390 |
| 87LFA5411 | 2.6 | 24.0 | <5 | 9.4 | <100 | 0.9 | 1.4 | <10 | 10.0 | 2.9 | 1 | 3 | 540 |
| 87LFA5417 | 2.3 | 16.0 | <5 | 4.3 | <100 | 1.2 | 0.6 | <10 | 8.4 | 4.4 | 3 | 3 | 590 |
| 87LFA5418 | 0.6 | 13.0 | <5 | 4.6 | <100 | 1.2 | 0.8 | <10 | 7.6 | 2.5 | 2 | 3 | 440 |
| 87LFA5419 | 0.9 | 12.0 | <5 | 4.7 | <100 | 1.3 | 0.5 | <10 | 8.4 | 2.5 | 2 | 2 | 570 |
| 87LFA5420 | 0.8 | 12.0 | <5 | 4.2 | <100 | 1.2 | 0.8 | <10 | 8.4 | 2.4 | 2 | 2 | 890 |
| 87LFA5421 | 0.7 | 12.0 | <5 | 4.6 | <100 | 1.1 | 0.8 | <10 | 8.5 | 2.4 | 1 | 3 | 790 |
| 87LFA5422 | 0.9 | 15.0 | <5 | 4.0 | <100 | 1.1 | 0.5 | <10 | 11.0 | 2.3 | 1 | 2 | 530 |
| 87LFA5423 | 0.6 | 12.0 | <5 | 3.7 | <100 | 0.9 | 0.6 | <10 | 9.1 | 2.4 | <1 | 2 | 490 |
| 87LFA5424 | 0.7 | 10.0 | <5 | 4.0 | <100 | 1.1 | 0.7 | <10 | 9.4 | 2.6 | <1 | 2 | 600 |
| 87LFA5425 | 1.0 | 14.0 | <5 | 6.2 | <100 | 1.2 | 0.8 | <10 | 9.1 | 2.8 | 1 | 3 | 610 |
| 87LFA5426 | 0.7 | 10.0 | <5 | 4.3 | <100 | 0.9 | 0.7 | <10 | 8.5 | 2.3 | <1 | 2 | 410 |
| 87LFA5427 | 0.7 | 13.0 | <5 | 5.3 | <100 | 1.2 | 1.0 | <10 | 9.0 | 2.6 | 1 | 3 | 640 |
| 87LFA5429 | 0.7 | 11.0 | <5 | 3.9 | <100 | 1.3 | 0.5 | <10 | 8.0 | 2.3 | <1 | 2 | 360 |
| 87LFA5430 | 0.2 | 2.7 | <5 | 0.9 | <100 | <0.5 | <0.5 | <10 | 2.0 | 0.6 | <1 | <1 | <200 |
| ML980001 | 0.9 | 7.8 | <5 | 3.5 | <100 | 1.2 | <0.5 | <10 | 7.6 | 2.4 | <1 | 1 | <200 |
| ML980002 | 1.4 | 10.0 | <5 | 3.5 | <100 | 0.8 | 0.7 | <10 | 8.5 | 2.5 | 1 | 1 | <200 |
| ML980003 | 0.9 | 12.0 | <5 | 4.4 | <100 | 0.9 | 0.9 | <10 | 8.3 | 2.5 | 2 | 2 | 320 |
| ML980004 | 0.9 | 12.0 | <5 | 4.0 | <100 | 0.9 | 0.6 | <10 | 8.2 | 2.6 | 1 | 2 | 280 |
| ML980005 | 0.6 | 10.0 | <5 | 4.1 | <100 | 1.0 | <0.5 | <10 | 7.0 | 2.3 | <1 | 1 | 300 |
| ML980006 | 0.6 | 12.0 | <5 | 4.7 | <100 | 1.1 | <0.5 | <10 | 10.0 | 2.8 | 1 | 2 | 330 |
| ML980007 | 0.6 | 14.0 | <5 | 4.3 | <100 | 0.9 | 0.6 | <10 | 9.1 | 2.3 | 1 | 2 | 310 |
| ML980008 | 0.3 | 13.0 | <5 | 4.7 | <100 | 0.9 | 0.8 | <10 | 10.0 | 2.2 | 1 | 2 | <200 |
| ML980009 | 0.2 | 11.0 | <5 | 3.9 | <100 | <0.5 | 0.8 | <10 | 10.0 | 2.6 | <1 | 1 | <200 |
| ML980010 | 0.9 | 13.0 | <5 | 4.1 | <100 | 0.9 | 0.6 | <10 | 7.7 | 2.4 | 1 | 2 | <200 |
| ML980011 | 1.1 | 10.0 | <5 | 3.4 | <100 | 1.2 | 0.5 | <10 | 7.5 | 2.4 | 2 | 1 | <200 |
| ML980012 | 0.8 | 11.0 | <5 | 4.2 | <100 | 0.9 | 0.8 | <10 | 8.8 | 2.5 | 1 | 2 | 490 |
| ML980013 | 0.7 | 10.0 | <5 | 4.1 | <100 | 0.9 | 0.5 | <10 | 7.4 | 2.6 | 1 | 2 | 320 |
| ML980014 | 0.6 | 12.0 | <5 | 4.4 | <100 | 1.1 | <0.5 | <10 | 8.7 | 2.3 | 1 | 2 | 320 |
| ML980015 | 0.5 | 16.0 | <5 | 5.2 | <100 | 1.0 | 1.0 | <10 | 7.8 | 2.7 | <1 | 2 | 280 |
| ML980016 | 0.4 | 16.0 | <5 | 5.2 | <100 | 0.5 | 0.7 | <10 | 11.0 | 2.6 | 1 | 2 | <200 |
| ML980017 | 1.0 | 13.0 | <5 | 4.1 | <100 | 0.9 | 0.7 | <10 | 7.9 | 2.4 | 2 | 1 | 280 |
| ML980018 | 0.8 | 11.0 | <5 | 4.2 | <100 | 0.9 | 0.6 | <10 | 8.4 | 2.8 | 1 | 2 | 370 |
| ML980019 | 0.8 | 12.0 | <5 | 4.0 | <100 | 0.9 | 0.6 | <10 | 7.6 | 2.5 | 2 | 2 | <200 |
| ML980020 | 0.9 | 11.0 | <5 | 4.3 | <100 | 1.1 | <0.5 | <10 | 8.5 | 2.8 | 3 | 2 | <200 |
| ML980021 | 0.9 | 10.0 | <5 | 4.2 | <100 | 0.6 | 0.6 | <10 | 7.5 | 2.4 | 1 | 1 | <200 |
| ML980022 | 0.9 | 10.0 | <5 | 4.1 | <100 | 1.3 | 0.8 | <10 | 8.1 | 2.7 | <1 | 2 | 310 |
| ML980023 | 0.8 | 10.0 | <5 | 2.9 | <100 | 0.7 | 0.6 | <10 | 5.8 | 2.1 | 2 | 1 | 390 |
| ML980024 | 0.7 | 10.0 | <5 | 3.7 | <100 | 1.2 | 0.6 | <10 | 7.3 | 2.6 | 1 | 2 | 250 |
| ML980025 | 0.7 | 11.0 | <5 | 4.5 | <100 | 0.9 | 0.6 | <10 | 7.3 | 2.4 | 1 | 2 | 290 |
| ML980026 | 2.3 | 13.0 | <5 | 6.8 | <100 | 0.8 | 0.7 | <10 | 9.4 | 2.5 | 1 | 2 | 310 |
| ML980027 | 0.9 | 12.0 | <5 | 4.9 | <100 | 1.3 | 0.8 | <10 | 9.0 | 2.9 | 1 | 3 | 390 |
| ML980028 | 0.8 | 15.0 | <5 | 5.5 | <100 | 0.9 | 0.8 | <10 | 12.0 | 2.8 | <1 | 2 | <200 |
| ML980029 | 1.1 | 12.0 | <5 | 4.1 | <100 | 1.2 | 0.8 | <10 | 8.8 | 2.4 | 2 | 1 | <200 |
| ML980030 | 1.1 | 13.0 | <5 | 4.1 | <100 | 1.0 | 0.8 | <10 | 7.6 | 2.4 | 1 | 1 | <200 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | Sb ppm INAA | Sc ppm INAA | Se ppm INAA | Sm ppm INAA | Sn ppm INAA | Ta ppm INAA | Tb ppm INAA | Te ppm INAA | Th ppm INAA | U ppm INAA | W ppm INAA | Yb ppm INAA | Zr ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ML980031 | 0.9 | 11.0 | <5 | 3.7 | <100 | 0.8 | <0.5 | <10 | 7.5 | 2.4 | 1 | 1 | 320 |
| ML980032 | 0.8 | 11.0 | <5 | 3.8 | <100 | 0.8 | 0.6 | <10 | 7.6 | 2.5 | 1 | 1 | 310 |
| ML980033 | 1.2 | 8.9 | <5 | 2.3 | <100 | 0.8 | <0.5 | <10 | 5.6 | 2.3 | 1 | 1 | 230 |
| ML980034 | 1.2 | 11.0 | <5 | 4.3 | <100 | 1.1 | 0.8 | <10 | 8.6 | 2.6 | <1 | 2 | 200 |
| ML980035 | 1.1 | 10.0 | <5 | 3.7 | <100 | 1.0 | 0.8 | <10 | 7.8 | 2.4 | <1 | 2 | 360 |
| ML980036 | 1.1 | 13.0 | <5 | 3.8 | <100 | 0.6 | 1.0 | <10 | 8.8 | 2.6 | <1 | 2 | <200 |
| ML980037 | 1.2 | 13.0 | <5 | 4.5 | <100 | 0.7 | 0.5 | <10 | 7.5 | 2.6 | 1 | 1 | 360 |
| ML980038 | 1.1 | 15.0 | <5 | 7.0 | <100 | 0.7 | 1.0 | <10 | 8.1 | 3.7 | <1 | 2 | <200 |
| ML980039 | 1.6 | 12.0 | <5 | 4.2 | <100 | 0.9 | 0.7 | <10 | 7.8 | 2.5 | 1 | 2 | <200 |
| ML980040 | 0.8 | 15.0 | <5 | 4.8 | <100 | 0.8 | 1.2 | <10 | 8.6 | 2.7 | 1 | 1 | <200 |
| ML980041 | 1.9 | 17.0 | <5 | 4.3 | <100 | 0.8 | 0.6 | <10 | 11.0 | 2.9 | <1 | 2 | <200 |
| ML980042 | 3.3 | 17.0 | <5 | 6.4 | <100 | 1.0 | 1.0 | <10 | 8.4 | 4.4 | <1 | 2 | <200 |
| ML980043 | 0.9 | 17.0 | <5 | 3.4 | <100 | 0.8 | <0.5 | <10 | 7.1 | 2.1 | <1 | 2 | <200 |
| ML980044 | 0.8 | 11.0 | <5 | 4.8 | <100 | 1.0 | 0.7 | <10 | 8.5 | 3.0 | <1 | 2 | 290 |
| ML980045 | 0.7 | 10.0 | <5 | 4.0 | <100 | 1.2 | <0.5 | <10 | 7.8 | 2.6 | 1 | 1 | 400 |
| ML980046 | 0.7 | 13.0 | <5 | 5.9 | <100 | 1.4 | 0.9 | <10 | 10.0 | 3.3 | 1 | 2 | 320 |
| ML980047 | 0.7 | 13.0 | <5 | 7.6 | <100 | 1.1 | 0.8 | <10 | 10.0 | 3.2 | 2 | 2 | 460 |
| ML980048 | 0.4 | 17.0 | <5 | 5.7 | <100 | 0.6 | 0.8 | <10 | 11.0 | 2.6 | 1 | 2 | <200 |
| ML980049 | 0.7 | 11.0 | <5 | 4.7 | <100 | 1.1 | 0.8 | <10 | 8.7 | 2.9 | 4 | 2 | 420 |
| ML980050 | 0.6 | 11.0 | <5 | 3.9 | <100 | 1.1 | <0.5 | <10 | 8.6 | 2.8 | 5 | 2 | 250 |
| ML980051 | 0.1 | 17.0 | <5 | 3.6 | <100 | 0.6 | 0.7 | <10 | 8.8 | 2.0 | 1 | 1 | <200 |
| ML980052 | 0.2 | 12.0 | <5 | 3.3 | <100 | 0.6 | 0.5 | <10 | 8.0 | 2.3 | 1 | 1 | <200 |
| ML980053 | 0.9 | 17.0 | <5 | 4.8 | <100 | 0.9 | 0.9 | <10 | 10.0 | 2.7 | 8 | 2 | 230 |
| ML980054 | 0.2 | 17.0 | <5 | 4.9 | <100 | 0.9 | 0.7 | <10 | 11.0 | 2.5 | <1 | 2 | 300 |
| ML980055 | 0.2 | 18.0 | <5 | 5.1 | <100 | 0.5 | 0.7 | <10 | 10.0 | 2.3 | 2 | 1 | <200 |
| ML980056 | 0.8 | 13.0 | <5 | 4.7 | <100 | 0.9 | 0.9 | <10 | 9.2 | 2.7 | 3 | 2 | 510 |
| ML980057 | 1.0 | 10.0 | <5 | 4.6 | <100 | 1.0 | 0.7 | <10 | 8.9 | 2.6 | 1 | 2 | 360 |
| ML980058 | 1.0 | 13.0 | <5 | 5.1 | <100 | 0.9 | 0.6 | <10 | 8.4 | 2.5 | 1 | 2 | 330 |
| ML980059 | 0.8 | 15.0 | <5 | 5.2 | <100 | 0.6 | 0.7 | <10 | 8.4 | 2.3 | 1 | 1 | <200 |
| ML980060 | 0.8 | 10.0 | <5 | 4.2 | <100 | 1.1 | 0.5 | <10 | 7.9 | 2.6 | <1 | 2 | 350 |
| ML980061 | 1.1 | 11.0 | <5 | 4.3 | <100 | 1.1 | <0.5 | <10 | 8.7 | 2.7 | 1 | 2 | 420 |
| ML980062 | 0.8 | 11.0 | <5 | 4.5 | <100 | 1.7 | 0.9 | <10 | 10.0 | 3.5 | 1 | 2 | <200 |
| ML980063 | 0.7 | 10.0 | <5 | 3.8 | <100 | 1.2 | <0.5 | <10 | 8.5 | 2.6 | 2 | 2 | <200 |
| ML980064 | 0.1 | 16.0 | <5 | 3.5 | <100 | 0.8 | <0.5 | <10 | 7.9 | 2.0 | 3 | 1 | <200 |
| ML980065 | 0.5 | 14.0 | <5 | 4.4 | <100 | 0.9 | 0.7 | <10 | 9.5 | 2.6 | 4 | 2 | 370 |
| ML980066 | 0.7 | 12.0 | <5 | 5.7 | <100 | 0.7 | 1.1 | <10 | 8.8 | 3.1 | 12 | 2 | 360 |
| ML980067 | 0.6 | 11.0 | <5 | 3.8 | <100 | 0.7 | 0.6 | <10 | 9.3 | 2.4 | 5 | 1 | 260 |
| ML980068 | 0.3 | 11.0 | <5 | 3.4 | <100 | 1.1 | 0.9 | <10 | 8.1 | 3.7 | 67 | 1 | 300 |
| ML980069 | 0.3 | 5.9 | <5 | 2.9 | <100 | 0.9 | <0.5 | <10 | 8.5 | 3.4 | 14 | 1 | 450 |
| ML980070 | 0.3 | 17.0 | <5 | 4.8 | <100 | 1.2 | 0.7 | <10 | 9.0 | 2.7 | 5 | 2 | 300 |
| ML980071 | 0.3 | 14.0 | <5 | 4.7 | <100 | 1.3 | 0.7 | <10 | 14.0 | 3.3 | 2 | 2 | 350 |
| ML980072 | 0.3 | 16.0 | <5 | 3.9 | <100 | 1.1 | 0.8 | <10 | 7.4 | 2.9 | 8 | 2 | 400 |
| ML980073 | 0.6 | 15.0 | <5 | 4.7 | <100 | 0.9 | 0.5 | <10 | 11.0 | 3.1 | 8 | 2 | <200 |
| ML980074 | 0.6 | 12.0 | <5 | 4.3 | <100 | 0.8 | 0.7 | <10 | 10.0 | 2.9 | 5 | 2 | 480 |
| ML980075 | 0.8 | 12.0 | <5 | 5.0 | <100 | 1.1 | 0.9 | <10 | 8.3 | 2.5 | 2 | 2 | 260 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | Sb ppm INAA | Sc ppm INAA | Se ppm INAA | Sm ppm INAA | Sn ppm INAA | Ta ppm INAA | Tb ppm INAA | Te ppm INAA | Th ppm INAA | U ppm INAA | W ppm INAA | Yb ppm INAA | Zr ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ML980076 | 0.9 | 12.0 | <5 | 11.3 | <100 | 1.0 | 1.4 | <10 | 8.6 | 4.6 | 23 | 3 | 330 |
| ML980077 | 0.8 | 12.0 | <5 | 4.4 | <100 | 1.1 | 0.7 | <10 | 9.3 | 2.6 | 4 | 1 | <200 |
| ML980078 | 0.4 | 11.0 | <5 | 3.7 | <100 | 1.0 | 0.6 | <10 | 10.0 | 2.9 | 10 | 2 | <200 |
| ML980079 | 0.3 | 14.0 | <5 | 3.7 | <100 | 1.4 | 0.8 | <10 | 8.4 | 3.1 | 21 | 2 | <200 |
| ML980080 | 0.4 | 12.0 | <5 | 4.1 | <100 | 1.1 | 0.6 | <10 | 9.2 | 2.5 | 6 | 1 | 240 |
| ML980081 | 0.5 | 12.0 | <5 | 4.2 | <100 | 1.3 | 0.5 | <10 | 10.0 | 2.6 | 4 | 2 | <200 |
| ML980082 | 0.5 | 12.0 | <5 | 4.1 | <100 | <0.5 | 0.7 | <10 | 8.0 | 2.2 | 3 | 2 | 270 |
| ML980083 | 0.5 | 8.9 | <5 | 4.0 | <100 | 1.2 | 0.6 | <10 | 6.6 | 2.9 | 14 | 2 | 320 |
| ML980084 | 0.2 | 15.0 | <5 | 4.2 | <100 | 0.6 | 0.6 | <10 | 10.0 | 2.6 | 2 | 2 | <200 |
| ML980085 | 0.3 | 11.0 | <5 | 5.6 | <100 | 1.1 | 0.8 | <10 | 9.2 | 3.1 | 7 | 1 | <200 |
| ML980086 | 0.3 | 13.0 | <5 | 4.9 | <100 | 1.2 | 0.6 | <10 | 10.0 | 3.4 | 15 | 1 | 430 |
| ML980087 | 0.4 | 12.0 | <5 | 4.2 | <100 | 1.2 | 0.6 | <10 | 8.5 | 2.7 | 4 | 2 | 310 |
| ML980088 | 0.4 | 13.0 | <5 | 4.4 | <100 | 0.8 | 0.6 | <10 | 9.4 | 2.7 | 3 | 1 | 270 |
| ML980089 | 0.5 | 11.0 | <5 | 4.2 | <100 | 1.1 | 0.8 | <10 | 8.3 | 2.6 | 2 | 2 | 330 |
| ML980090 | 0.5 | 10.0 | <5 | 4.2 | <100 | 1.0 | 0.6 | <10 | 8.7 | 2.5 | 4 | 2 | 350 |
| ML980091 | 0.7 | 11.0 | <5 | 4.7 | <100 | 0.9 | 0.7 | <10 | 8.4 | 2.5 | 3 | 2 | <200 |
| ML980092 | 0.8 | 12.0 | <5 | 5.3 | <100 | 1.0 | 1.0 | <10 | 11.0 | 2.9 | 5 | 2 | 410 |
| ML980093 | 0.8 | 12.0 | <5 | 5.1 | <100 | 1.0 | 0.6 | <10 | 10.0 | 2.7 | 2 | 1 | 260 |
| ML980094 | 0.3 | 13.0 | <5 | 4.4 | <100 | 0.9 | 0.7 | <10 | 8.9 | 2.6 | 4 | 2 | 260 |
| ML980095 | 0.4 | 11.0 | <5 | 4.6 | <100 | 1.0 | 0.8 | <10 | 9.3 | 2.9 | 2 | 2 | 650 |
| ML980096 | 0.6 | 12.0 | <5 | 4.1 | <100 | 1.1 | 0.8 | <10 | 9.2 | 2.4 | 4 | 1 | 340 |
| ML980097 | 0.4 | 13.0 | <5 | 4.2 | 150 | 1.2 | 0.6 | <10 | 8.4 | 2.4 | 2 | 2 | 410 |
| ML980098 | 0.4 | 14.0 | <5 | 4.9 | <100 | 1.1 | 0.5 | <10 | 9.1 | 2.4 | 6 | 2 | 390 |
| ML980099 | 0.5 | 12.0 | <5 | 5.5 | <100 | 1.3 | 1.0 | <10 | 9.4 | 3.0 | 3 | 2 | 450 |
| ML980100 | 0.3 | 13.0 | <5 | 3.6 | <100 | 0.7 | 0.7 | <10 | 8.7 | 2.1 | 3 | 1 | 230 |
| ML980101 | 0.5 | 17.0 | <5 | 5.8 | <100 | 1.0 | 1.2 | <10 | 8.0 | 2.7 | 3 | 2 | <200 |
| ML980102 | 0.6 | 12.0 | <5 | 4.3 | <100 | 0.9 | 0.7 | <10 | 8.6 | 2.5 | 3 | 1 | 440 |
| ML980103 | 0.3 | 12.0 | <5 | 4.4 | <100 | 0.7 | <0.5 | <10 | 9.4 | 2.6 | 5 | 1 | <200 |
| ML980104 | 0.4 | 12.0 | <5 | 4.7 | <100 | 0.8 | <0.5 | <10 | 6.5 | 2.1 | 3 | 1 | <200 |
| ML980105 | 0.6 | 12.0 | <5 | 5.1 | <100 | 1.2 | 1.0 | <10 | 10.0 | 2.6 | 3 | 1 | <200 |
| ML980106 | 0.7 | 12.0 | <5 | 5.9 | <100 | 1.1 | 0.9 | <10 | 10.0 | 2.9 | 2 | 2 | 360 |
| ML980107 | 0.4 | 10.0 | <5 | 4.2 | <100 | 1.3 | 0.6 | <10 | 7.7 | 2.8 | 2 | 2 | 300 |
| ML980108 | 0.6 | 13.0 | <5 | 4.7 | <100 | 1.0 | 0.6 | <10 | 10.0 | 2.5 | <1 | 2 | 220 |
| ML980109 | 0.3 | 14.0 | <5 | 3.6 | <100 | 1.0 | <0.5 | <10 | 8.8 | 2.3 | <1 | 2 | 200 |
| ML980110 | 0.5 | 31.0 | <5 | 5.6 | <100 | 0.9 | 1.0 | <10 | 3.0 | 1.2 | 5 | 2 | <200 |
| MP990001 | 0.3 | 9.4 | <5 | 2.3 | <100 | 0.7 | <0.5 | <10 | 5.8 | 2.0 | <1 | 2 | <200 |
| MP990002 | 0.4 | 11.0 | <5 | 3.1 | <100 | 0.9 | 0.6 | <10 | 6.6 | 2.2 | <1 | 3 | 380 |
| MP990003 | 2.8 | 20.7 | <5 | 8.4 | <100 | 0.9 | 1.1 | <10 | 9.1 | 2.3 | <1 | 4 | <200 |
| MP990005 | 0.7 | 11.0 | <5 | 4.1 | <100 | 1.3 | 0.7 | <10 | 9.3 | 2.3 | 2 | 3 | 480 |
| MP990006 | 0.5 | 8.8 | <5 | 3.9 | <100 | 0.8 | 0.9 | <10 | 7.8 | 2.3 | <1 | 3 | 530 |
| MP990007 | 0.7 | 8.3 | <5 | 5.0 | <100 | 1.6 | 0.8 | <10 | 12.0 | 3.1 | <1 | 4 | 370 |
| MP990008 | 0.7 | 10.0 | <5 | 3.1 | <100 | 1.1 | <0.5 | <10 | 6.3 | 2.0 | 1 | 2 | <200 |
| MP990009 | 1.0 | 12.0 | <5 | 2.9 | <100 | 0.8 | <0.5 | <10 | 7.1 | 2.0 | <1 | 2 | <200 |
| MP990010 | 0.5 | 8.9 | <5 | 7.1 | <100 | 1.6 | 1.1 | <10 | 7.7 | 3.0 | 1 | 5 | 400 |
| MP990011 | 0.7 | 10.0 | <5 | 3.6 | <100 | 0.9 | 0.6 | <10 | 8.4 | 2.1 | <1 | 2 | <200 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | Sb ppm INAA | Sc ppm INAA | Se ppm INAA | Sm ppm INAA | Sn ppm INAA | Ta ppm INAA | Tb ppm INAA | Te ppm INAA | Th ppm INAA | U ppm INAA | W ppm INAA | Yb ppm INAA | Zr ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MP990012 | 0.9 | 12.0 | <5 | 4.9 | <100 | 1.5 | 0.9 | <10 | 8.6 | 2.6 | <1 | 3 | 500 |
| MP990013 | 0.6 | 10.0 | <5 | 4.3 | <100 | 1.4 | 0.6 | <10 | 11.0 | 2.8 | <1 | 4 | 470 |
| MP990014 | 0.5 | 10.0 | <5 | 3.8 | <100 | 1.2 | 0.6 | <10 | 7.2 | 2.6 | <1 | 2 | 320 |
| MP990016 | 0.9 | 13.0 | <5 | 3.1 | <100 | 0.7 | <0.5 | <10 | 7.6 | 2.0 | <1 | 3 | <200 |
| MP990017 | 0.9 | 9.2 | <5 | 3.1 | <100 | 1.0 | <0.5 | <10 | 7.4 | 2.4 | <1 | 3 | <200 |
| MP990018 | 0.9 | 10.0 | <5 | 3.3 | <100 | 1.0 | <0.5 | <10 | 8.0 | 2.3 | <1 | 3 | <200 |
| MP990019 | 0.5 | 8.5 | <5 | 3.9 | <100 | 1.0 | <0.5 | <10 | 8.1 | 2.4 | 1 | 3 | <200 |
| MP990020 | 0.2 | 4.8 | <5 | 6.0 | <100 | 0.7 | 0.9 | <10 | 5.9 | 1.6 | <1 | 3 | <200 |
| MP990021 | 0.4 | 12.0 | <5 | 3.2 | <100 | 0.8 | 0.5 | <10 | 7.8 | 2.2 | 1 | 3 | <200 |
| MP990022 | 0.6 | 13.0 | <5 | 3.3 | <100 | 0.9 | <0.5 | <10 | 10.0 | 2.1 | <1 | 2 | <200 |
| MP990023 | 0.6 | 10.0 | <5 | 3.4 | <100 | 1.6 | <0.5 | <10 | 12.0 | 2.9 | 1 | 4 | 480 |
| MP990024 | 1.4 | 10.0 | <5 | 3.0 | <100 | 1.3 | 0.6 | <10 | 7.8 | 2.3 | <1 | 2 | <200 |
| MP990025 | 0.8 | 11.0 | <5 | 4.4 | <100 | 1.0 | <0.5 | <10 | 7.6 | 2.6 | <1 | 3 | <200 |
| MP990026 | 0.9 | 12.0 | <5 | 4.7 | <100 | 1.3 | 0.6 | <10 | 7.4 | 2.0 | <1 | 3 | 340 |
| MP990027 | 0.7 | 11.0 | <5 | 3.7 | <100 | 1.7 | 0.8 | <10 | 7.1 | 2.0 | <1 | 2 | 420 |
| MP990028 | 0.6 | 13.0 | <5 | 3.8 | <100 | 1.0 | <0.5 | <10 | 6.4 | 2.1 | <1 | 4 | <200 |
| MP990029 | 0.9 | 14.0 | <5 | 5.6 | <100 | 0.9 | 0.7 | <10 | 7.5 | 2.4 | 2 | 4 | <200 |
| MP990030 | 0.7 | 8.6 | <5 | 4.6 | <100 | 1.4 | 0.7 | <10 | 11.0 | 2.5 | 1 | 4 | 560 |
| MP990031 | 0.2 | 15.0 | <5 | 2.8 | <100 | <0.5 | <0.5 | <10 | 2.0 | 1.3 | <1 | 2 | <200 |
| MP990033 | 0.4 | 9.0 | <5 | 2.4 | <100 | 1.0 | <0.5 | <10 | 6.0 | 2.1 | <1 | 2 | <200 |
| MP990034 | 0.8 | 11.0 | <5 | 3.4 | <100 | 1.1 | 0.5 | <10 | 6.3 | 1.8 | <1 | 3 | <200 |
| MP990035 | 1.8 | 15.0 | <5 | 5.0 | <100 | 1.5 | 0.7 | <10 | 7.2 | 2.2 | <1 | 3 | 490 |
| MP990036 | 0.5 | 12.0 | <5 | 4.5 | <100 | 1.1 | 0.8 | <10 | 7.7 | 2.4 | 1 | 4 | <200 |
| MP990037 | 0.4 | 6.0 | <5 | 4.7 | <100 | 1.0 | 0.8 | <10 | 25.2 | 5.5 | <1 | 4 | 450 |
| MP990038 | 0.6 | 15.0 | <5 | 8.5 | <100 | 0.9 | 1.1 | <10 | 9.5 | 3.2 | <1 | 7 | 580 |
| MP990039 | 0.7 | 13.0 | <5 | 3.1 | <100 | 1.1 | <0.5 | <10 | 8.0 | 1.9 | <1 | 3 | 430 |
| MP990040 | 0.6 | 12.0 | <5 | 7.3 | <100 | 1.1 | 1.3 | <10 | 7.7 | 3.0 | <1 | 5 | 380 |
| MP990041 | 0.6 | 8.9 | <5 | 4.8 | <100 | 1.4 | 0.8 | <10 | 8.9 | 2.8 | <1 | 5 | 570 |
| MP990042 | 0.4 | 8.6 | <5 | 5.0 | <100 | 1.2 | <0.5 | <10 | 9.1 | 2.8 | 2 | 5 | 460 |
| MP990043 | 0.8 | 12.0 | <5 | 5.2 | <100 | 0.9 | 0.8 | <10 | 8.4 | 2.4 | <1 | 4 | <200 |
| MP990044 | 0.8 | 13.0 | <5 | 3.2 | <100 | 0.9 | 0.8 | <10 | 9.4 | 1.9 | <1 | 4 | <200 |
| MP990045 | 0.9 | 13.0 | <5 | 3.7 | <100 | 1.4 | <0.5 | <10 | 7.5 | 2.0 | <1 | 2 | <200 |
| MP990046 | 0.8 | 13.0 | <5 | 6.8 | <100 | 1.3 | 0.9 | <10 | 9.0 | 2.5 | <1 | 4 | 470 |
| MP990047 | 0.5 | 15.0 | <5 | 13.8 | <100 | 1.2 | 1.9 | <10 | 8.9 | 3.5 | <1 | 5 | <200 |
| MP990048 | 0.5 | 10.0 | <5 | 12.7 | <100 | 1.7 | 1.4 | <10 | 13.0 | 3.0 | <1 | 6 | 590 |
| MP990049 | 1.7 | 13.0 | <5 | 3.5 | <100 | 1.2 | 0.8 | <10 | 6.0 | 2.1 | 1 | 4 | <200 |
| MP990050 | 0.5 | 11.0 | <5 | 3.8 | <100 | 1.1 | <0.5 | <10 | 6.7 | 2.3 | <1 | 3 | <200 |
| MP990052 | 1.0 | 11.0 | <5 | 4.1 | <100 | 1.0 | 0.7 | <10 | 7.5 | 2.1 | 1 | 3 | <200 |
| MP990053 | 0.5 | 12.0 | <5 | 5.1 | <100 | 1.2 | 0.7 | <10 | 8.9 | 2.4 | <1 | 4 | 450 |
| MP990054 | 0.5 | 12.0 | <5 | 4.0 | <100 | 1.2 | 0.8 | <10 | 8.0 | 2.5 | <1 | 4 | 400 |
| MP990055 | 0.6 | 13.0 | <5 | 5.1 | <100 | 1.1 | 0.7 | <10 | 7.9 | 2.5 | <1 | 3 | <200 |
| MP990056 | 0.5 | 10.0 | <5 | 4.5 | <100 | 1.3 | 0.7 | <10 | 7.3 | 2.3 | <1 | 4 | 520 |
| MP990060 | 0.6 | 9.1 | <5 | 3.1 | <100 | 0.6 | <0.5 | <10 | 6.7 | 2.0 | <1 | 3 | <200 |
| MP990061 | 0.4 | 13.0 | <5 | 3.1 | <100 | 1.0 | <0.5 | <10 | 7.9 | 2.2 | <1 | 3 | <200 |
| MP990062 | 0.5 | 25.6 | <5 | 2.9 | <100 | 0.7 | <0.5 | <10 | 6.7 | 1.9 | <1 | 3 | <200 |

## APPENDIX IV-ii: INAA Analysis - Till

| Sample Number | Sb ppm INAA | Sc ppm INAA | Se ppm INAA | Sm ppm INAA | Sn ppm INAA | Ta ppm INAA | Tb ppm INAA | Te ppm INAA | Th ppm INAA | U ppm INAA | W ppm INAA | Yb ppm INAA | Zr ppm INAA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MP990063** | 0.7 | 10.0 | <5 | 3.9 | <100 | 1.1 | 0.5 | <10 | 8.2 | 2.4 | <1 | 3 | 450 |
| **MP990064** | 0.6 | 11.0 | <5 | 2.9 | <100 | 0.8 | 0.6 | <10 | 7.6 | 2.1 | <1 | 3 | <200 |
| **MP990065** | 1.0 | 12.0 | <5 | 4.8 | <100 | 1.3 | 0.7 | <10 | 8.6 | 2.9 | <1 | 3 | <200 |
| **MP990066** | 1.1 | 10.0 | <5 | 4.1 | <100 | 1.2 | 0.6 | <10 | 8.5 | 2.7 | <1 | 3 | 530 |
| **MP990067** | 0.7 | 11.0 | <5 | 4.8 | <100 | 1.4 | 0.6 | <10 | 17.0 | 3.7 | 2 | 5 | <200 |
| **MP990068** | 0.6 | 11.0 | <5 | 4.9 | <100 | 0.9 | 0.5 | <10 | 6.8 | 2.4 | <1 | 3 | 390 |

## APPENDIX IV-iii: AAS - Humus

| Sample Number | LOI % AAS | Ag ppm AAS | Cd ppm AAS | Co ppm AAS | Cu ppm AAS | Fe % AAS | Hg ppb AAS | Mn ppm AAS | Mo ppm AAS | Ni ppm AAS | Pb ppm AAS | V ppm AAS | Zn ppm AAS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ML980001 | 85.4 | 1.0 | 1.0 | <2 | 13 | 0.34 | 230 | 1980 | 2 | 6 | 66 | 10 | 110 |
| ML980002 | 87.7 | 1.3 | 0.7 | <2 | 13 | 0.42 | 230 | 233 | <1 | 7 | 59 | 15 | 89 |
| ML980003 | 76.3 | 1.2 | 1.8 | <2 | 17 | 0.46 | 210 | 360 | 1 | 8 | 64 | 20 | 145 |
| ML980004 | 43.5 | 0.8 | 1.0 | 3 | 14 | 1.0 | 160 | 356 | 2 | 11 | 38 | 23 | 92 |
| ML980005 | 91.5 | 0.4 | 0.6 | <2 | 9 | 0.22 | 180 | 24 | 2 | 6 | 15 | 11 | 48 |
| ML980006 | 74.8 | 0.2 | 0.7 | 2 | 12 | 0.71 | 180 | 1850 | 3 | 9 | 44 | 19 | 86 |
| ML980007 | 66.5 | 0.4 | 1.6 | 3 | 13 | 0.90 | 170 | 4750 | <1 | 16 | 57 | 31 | 228 |
| ML980008 | 79.2 | 0.3 | 0.3 | 2 | 12 | 0.73 | 210 | 845 | 1 | 8 | 110 | 32 | 123 |
| ML980009 | 57.6 | 0.5 | 0.8 | <2 | 15 | 0.22 | 150 | 112 | 1 | 8 | 57 | 16 | 86 |
| ML980010 | 79.3 | 0.4 | 0.8 | 2 | 11 | 0.48 | 270 | 717 | 1 | 7 | 65 | 24 | 101 |
| ML980011 | 80.5 | 1.8 | 2.3 | 2 | 14 | 0.45 | 290 | 5030 | 2 | 7 | 81 | 21 | 255 |
| ML980012 | 70.1 | 0.6 | 0.8 | 2 | 17 | 0.71 | 230 | 171 | 1 | 9 | 75 | 23 | 90 |
| ML980013 | 73.6 | 1.1 | 0.9 | 3 | 16 | 0.82 | 320 | 520 | 2 | 11 | 60 | 20 | 101 |
| ML980014 | 84.9 | 2.2 | 0.5 | <2 | 12 | 0.39 | 350 | 309 | 2 | 8 | 67 | 24 | 81 |
| ML980015 | 50.9 | 0.5 | 1.2 | <2 | 10 | 0.38 | 160 | 950 | 1 | 7 | 64 | 27 | 111 |
| ML980016 | 91.6 | 0.7 | 0.9 | <2 | 10 | 0.29 | 390 | 740 | 1 | 8 | 87 | 26 | 96 |
| ML980017 | 87.6 | 1.4 | 1.0 | <2 | 10 | 0.37 | 280 | 463 | 2 | 8 | 62 | 24 | 185 |
| ML980018 | 86.9 | 3.8 | 1.2 | <2 | 12 | 0.42 | 270 | 1990 | 3 | 7 | 65 | 25 | 114 |
| ML980019 | 73.0 | 2.0 | 1.5 | 2 | 13 | 0.57 | 280 | 1430 | 4 | 9 | 57 | 27 | 223 |
| ML980020 | 65.5 | 1.0 | 1.7 | 3 | 18 | 0.88 | 170 | 2700 | 2 | 13 | 46 | 23 | 254 |
| ML980021 | 89.2 | 0.6 | 0.8 | <2 | 12 | 0.43 | 290 | 73 | 4 | 8 | 64 | 24 | 91 |
| ML980022 | 84.7 | 1.8 | 0.9 | 2 | 13 | 0.52 | 400 | 1440 | 2 | 8 | 55 | 21 | 119 |
| ML980023 | 56.0 | 2.0 | 0.7 | 5 | 30 | 2.0 | 160 | 174 | 2 | 22 | 24 | 34 | 113 |
| ML980024 | 87.4 | 1.3 | 1.0 | <2 | 11 | 0.53 | 400 | 108 | 3 | 9 | 100 | 27 | 90 |
| ML980025 | 79.8 | 4.0 | 2.1 | 3 | 14 | 0.51 | 410 | 1890 | 1 | 11 | 95 | 25 | 111 |
| ML980026 | 83.9 | 2.0 | 2.3 | 4 | 15 | 0.46 | 290 | 7290 | 4 | 20 | 220 | 26 | 106 |
| ML980027 | 87.7 | 0.4 | 0.6 | <2 | 10 | 0.27 | 330 | 130 | 1 | 6 | 74 | 14 | 61 |
| ML980028 | 63.9 | 0.4 | 1.8 | 2 | 11 | 0.60 | 190 | 3800 | 2 | 11 | 70 | 30 | 164 |
| ML980029 | 64.1 | 2.0 | 0.7 | 3 | 20 | 1.2 | 210 | 675 | 2 | 13 | 69 | 32 | 113 |
| ML980030 | 73.7 | 0.7 | 1.1 | 3 | 14 | 0.83 | 330 | 3630 | <1 | 13 | 65 | 27 | 108 |
| ML980031 | 79.8 | 1.5 | 1.5 | 2 | 11 | 0.48 | 340 | 1450 | 2 | 9 | 80 | 23 | 94 |
| ML980032 | 81.4 | 2.3 | 1.3 | 2 | 12 | 0.46 | 310 | 416 | 2 | 7 | 83 | 18 | 123 |
| ML980033 | 71.3 | 14.5 | 4.6 | 5 | 16 | 0.72 | 230 | 6600 | 2 | 10 | 128 | 22 | 195 |
| ML980034 | 53.7 | 0.5 | 0.7 | 5 | 20 | 1.5 | 300 | 1820 | 1 | 18 | 58 | 26 | 98 |
| ML980035 | 77.9 | 2.0 | 1.2 | 3 | 14 | 0.68 | 210 | 1930 | 2 | 11 | 50 | 20 | 170 |
| ML980036 | 75.9 | 1.0 | 1.5 | 4 | 18 | 0.79 | 160 | 617 | 1 | 15 | 31 | 17 | 273 |
| ML980037 | 78.5 | 4.0 | 1.4 | 9 | 72 | 1.3 | 330 | 99 | <1 | 20 | 122 | 21 | 84 |
| ML980038 | 83.0 | 0.8 | 0.8 | <2 | 20 | 0.40 | 270 | 82 | 1 | 14 | 47 | 12 | 45 |
| ML980039 | 73.0 | 2.1 | 7.3 | 3 | 21 | 0.54 | 300 | 3580 | 2 | 11 | 90 | 16 | 240 |
| ML980040 | 89.3 | 1.6 | 0.6 | <2 | 10 | 0.25 | 360 | 185 | 1 | 5 | 59 | 10 | 37 |
| ML980041 | 64.2 | 0.4 | 2.5 | 6 | 20 | 1.4 | 290 | 5400 | 2 | 21 | 79 | 22 | 264 |
| ML980042 | 85.2 | 1.4 | 1.1 | 3 | 18 | 0.52 | 360 | 1390 | 1 | 14 | 43 | 24 | 71 |
| ML980043 | 33.3 | 0.4 | 1.8 | 8 | 18 | 1.8 | 210 | 4000 | <1 | 28 | 74 | 25 | 162 |
| ML980044 | 81.2 | 1.0 | 1.0 | <2 | 10 | 0.48 | 370 | 488 | <1 | 7 | 83 | 22 | 115 |
| ML980045 | 55.2 | 1.5 | 0.5 | 27 | 16 | 1.2 | 230 | 1230 | 1 | 14 | 55 | 19 | 56 |
| ML980046 | 80.7 | 1.0 | 2.1 | 5 | 20 | 0.61 | 230 | 2660 | 2 | 15 | 52 | 23 | 100 |

## APPENDIX IV-iii: AAS - Humus

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ML980047** | 68.7 | 1.6 | 2.3 | 9 | 29 | 1.5 | 190 | 4240 | 9 | 24 | 51 | 28 | 69 |
| **ML980048** | 83.3 | 0.4 | 1.5 | 2 | 17 | 0.46 | 170 | 1550 | 2 | 8 | 39 | 14 | 194 |
| **ML980049** | 93.6 | 2.4 | 0.7 | <2 | 10 | 0.16 | 290 | 53 | 1 | 6 | 58 | 16 | 50 |
| **ML980050** | 78.4 | 2.1 | 1.0 | <2 | 10 | 0.36 | 350 | 440 | 2 | 7 | 59 | 11 | 79 |
| **ML980051** | 56.2 | 0.4 | 0.7 | 2 | 11 | 0.66 | 140 | 1070 | 1 | 9 | 54 | 42 | 63 |
| **ML980052** | 67.3 | 0.5 | 2.8 | 3 | 26 | 1.2 | 340 | 5270 | 6 | 14 | 76 | 34 | 309 |
| **ML980053** | 91.8 | 1.1 | 1.6 | 2 | 10 | 0.21 | 410 | 61 | 9 | 7 | 49 | 15 | 94 |
| **ML980054** | 82.4 | 0.7 | 1.0 | <2 | 12 | 0.37 | 330 | 1340 | 3 | 6 | 94 | 20 | 122 |
| **ML980055** | 60.6 | 1.2 | 0.6 | 3 | 15 | 0.74 | 170 | 606 | 1 | 9 | 58 | 44 | 97 |
| **ML980056** | 85.8 | 1.0 | 1.7 | 2 | 13 | 0.48 | 360 | 1770 | 3 | 9 | 75 | 12 | 194 |
| **ML980057** | 77.3 | 0.8 | 0.5 | <2 | 9 | 0.32 | 230 | 194 | 2 | 7 | 53 | 11 | 67 |
| **ML980058** | 87.1 | 0.7 | 1.1 | 2 | 10 | 0.20 | 220 | 480 | <1 | 10 | 49 | 14 | 125 |
| **ML980059** | 89.4 | 0.4 | 1.0 | <2 | 9 | 0.24 | 380 | 537 | 2 | 5 | 79 | 13 | 86 |
| **ML980060** | 84.7 | 1.3 | 0.8 | 2 | 11 | 0.29 | 320 | 375 | 1 | 6 | 70 | 15 | 79 |
| **ML980061** | 89.1 | 1.0 | 0.8 | <2 | 10 | 0.21 | 270 | 470 | <1 | 5 | 64 | 10 | 73 |
| **ML980062** | 94.3 | 0.8 | 0.7 | <2 | 7 | 0.12 | 310 | 309 | 2 | 4 | 39 | 12 | 94 |
| **ML980063** | 89.1 | 0.7 | 0.6 | <2 | 9 | 0.28 | 270 | 138 | 2 | 6 | 77 | 16 | 63 |
| **ML980064** | 75.4 | 0.4 | 0.7 | <2 | 15 | 0.57 | 230 | 670 | 4 | 10 | 76 | 38 | 74 |
| **ML980065** | 87.9 | 0.2 | 0.7 | <2 | 11 | 0.35 | 270 | 516 | 1 | 6 | 61 | 17 | 71 |
| **ML980066** | 93.0 | 0.7 | 0.6 | 3 | 26 | 0.16 | 200 | 44 | 50 | 9 | 23 | 14 | 52 |
| **ML980067** | 84.4 | 0.6 | 0.6 | 2 | 14 | 0.51 | 390 | 73 | 2 | 8 | 96 | 16 | 70 |
| **ML980068** | 52.7 | 1.0 | 0.7 | 2 | 35 | 1.1 | 220 | 1490 | 2 | 7 | 82 | 40 | 106 |
| **ML980069** | 89.5 | 0.4 | 0.6 | <2 | 12 | 0.26 | 290 | 342 | 2 | 6 | 71 | 11 | 100 |
| **ML980070** | 83.0 | 0.8 | 0.8 | <2 | 17 | 0.41 | 300 | 141 | 4 | 8 | 97 | 21 | 93 |
| **ML980071** | 66.7 | 0.9 | 0.8 | 2 | 13 | 0.45 | 290 | 1460 | 3 | 6 | 78 | 24 | 69 |
| **ML980072** | 85.2 | 0.3 | 0.6 | 9 | 35 | 0.46 | 250 | 695 | 16 | 10 | 69 | 22 | 58 |
| **ML980073** | 70.0 | 0.6 | 0.5 | 2 | 11 | 0.25 | 260 | 54 | 2 | 5 | 53 | 13 | 47 |
| **ML980074** | 89.4 | 1.0 | 0.6 | <2 | 10 | 0.35 | 300 | 340 | 3 | 7 | 56 | 10 | 78 |
| **ML980075** | 75.6 | 0.5 | 0.6 | 3 | 13 | 0.75 | 280 | 586 | 3 | 11 | 61 | 20 | 95 |
| **ML980076** | 70.8 | 3.0 | 0.8 | 13 | 288 | 1.1 | 230 | 1860 | 8 | 17 | 25 | 27 | 42 |
| **ML980077** | 88.5 | 2.1 | 0.7 | <2 | 10 | 0.28 | 390 | 590 | 2 | 7 | 89 | 12 | 89 |
| **ML980078** | 89.6 | 1.4 | 0.6 | <2 | 11 | 0.21 | 450 | 107 | 4 | 5 | 63 | 11 | 81 |
| **ML980079** | 88.2 | 0.6 | 0.6 | <2 | 9 | 0.28 | 440 | 96 | 3 | 7 | 67 | 16 | 68 |
| **ML980080** | 80.3 | 0.8 | 0.7 | <2 | 13 | 0.44 | 180 | 483 | 3 | 5 | 41 | 19 | 95 |
| **ML980081** | 53.5 | 0.8 | 0.8 | <2 | 17 | 0.47 | 200 | 1650 | 2 | 5 | 38 | 17 | 87 |
| **ML980082** | 86.1 | 1.1 | 0.5 | 2 | 14 | 0.45 | 370 | 389 | 7 | 11 | 69 | 12 | 75 |
| **ML980083** | 91.0 | 0.2 | 1.1 | <2 | 12 | 0.23 | 310 | 1570 | 2 | 8 | 75 | 10 | 151 |
| **ML980084** | 86.4 | 3.0 | 0.7 | <2 | 12 | 0.25 | 300 | 136 | 2 | 7 | 91 | 13 | 59 |
| **ML980085** | 85.7 | 3.7 | 2.1 | 2 | 72 | 0.42 | 270 | 5200 | 5 | 19 | 109 | 16 | 63 |
| **ML980086** | 78.2 | 0.8 | 0.6 | <2 | 18 | 0.46 | 250 | 58 | 4 | 7 | 43 | 26 | 43 |
| **ML980087** | 94.6 | 0.4 | 0.5 | <2 | 12 | 0.27 | 380 | 193 | 1 | 6 | 46 | 11 | 67 |
| **ML980088** | 91.2 | 0.5 | 1.2 | <2 | 14 | 0.17 | 210 | 990 | 2 | 5 | 41 | 9 | 178 |
| **ML980089** | 94.9 | 0.6 | 0.6 | <2 | 10 | 0.18 | 250 | 255 | 1 | 7 | 53 | 10 | 77 |
| **ML980091** | 80.6 | 1.0 | 0.7 | 3 | 17 | 0.46 | 350 | 320 | 2 | 14 | 55 | 14 | 81 |
| **ML980092** | 54.3 | 2.1 | 0.4 | 3 | 15 | 0.79 | 200 | 638 | 4 | 10 | 83 | 21 | 72 |
| **ML980093** | 66.6 | 1.0 | 0.2 | 2 | 8 | 0.50 | 220 | 134 | 3 | 7 | 91 | 24 | 46 |
| **ML980094** | 88.9 | 0.8 | 1.5 | 2 | 10 | 0.26 | 450 | 2050 | 2 | 8 | 69 | 17 | 164 |
| **ML980095** | 81.7 | 0.8 | 0.6 | <2 | 12 | 0.34 | 300 | 82 | 5 | 7 | 83 | 13 | 89 |

## APPENDIX IV-iii: AAS - Humus

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ML980096** | 72.8 | 0.6 | 1.0 | 9 | 17 | 0.41 | 190 | 5580 | 4 | 11 | 90 | 20 | 145 |
| **ML980097** | 86.8 | 1.2 | 0.8 | 5 | 15 | 0.36 | 290 | 267 | 2 | 11 | 63 | 10 | 108 |
| **ML980098** | 82.1 | 0.7 | 1.4 | 6 | 20 | 0.46 | 200 | 2980 | 4 | 12 | 56 | 22 | 141 |
| **ML980099** | 90.9 | 0.4 | 0.7 | 2 | 10 | 0.23 | 280 | 306 | 2 | 6 | 52 | 14 | 77 |
| **ML980100** | 92.7 | 0.5 | 0.5 | <2 | 13 | 0.14 | 200 | 229 | 1 | 6 | 41 | 11 | 68 |
| **ML980101** | 77.0 | 1.8 | 0.6 | 23 | 21 | 0.65 | 300 | 2950 | 8 | 15 | 95 | 21 | 40 |
| **ML980102** | 88.6 | 1.2 | 0.3 | 2 | 10 | 0.27 | 230 | 320 | 2 | 8 | 56 | 18 | 115 |
| **ML980103** | 88.1 | 2.6 | 0.6 | <2 | 13 | 0.24 | 360 | 87 | 2 | 7 | 91 | 10 | 88 |
| **ML980104** | 90.5 | 1.4 | 0.7 | 2 | 11 | 0.25 | 280 | 72 | 2 | 7 | 72 | 12 | 120 |
| **ML980105** | 22.1 | 1.4 | 0.4 | 2 | 9 | 0.38 | 270 | 60 | 1 | 8 | 70 | 18 | 61 |
| **ML980106** | 87.2 | 0.4 | 0.9 | 2 | 8 | 0.31 | 320 | 2400 | 2 | 10 | 55 | 10 | 97 |
| **ML980107** | 93.3 | 0.7 | 0.8 | <2 | 13 | 0.18 | 170 | 3510 | 2 | 6 | 43 | 15 | 158 |
| **ML980108** | 64.9 | 0.5 | 0.5 | 5 | 20 | 1.3 | 160 | 1030 | 4 | 15 | 60 | 19 | 110 |
| **ML980109** | 71.7 | 0.4 | 1.5 | 5 | 15 | 0.47 | 160 | 3050 | 3 | 14 | 81 | 13 | 199 |
| **ML980110** | 83.8 | 0.4 | 0.8 | 2 | 8 | 0.43 | 310 | 224 | 2 | 8 | 64 | 24 | 61 |

## APPENDIX IV-iv: INAA Analysis - Humus

| Sample Number | As ppm INAA | Au ppb INAA | Ba ppm INAA | Br ppm INAA | Ce ppm INAA | Cr ppm INAA | Cs ppm INAA |
|---|---|---|---|---|---|---|---|
| ML980001 | 2.0 | <2 | 180 | 3.7 | 8 | 32 | 0.7 |
| ML980002 | 3.3 | 3 | 130 | 8.0 | 11 | 31 | 1.1 |
| ML980003 | 2.1 | <2 | 130 | 4.7 | 9 | 34 | 0.6 |
| ML980004 | 4.0 | <2 | 190 | 3.8 | 22 | 180 | 0.9 |
| ML980005 | 2.0 | <2 | 80 | 16.0 | <5 | <20 | <0.5 |
| ML980006 | 4.6 | <2 | 120 | 5.3 | 15 | 37 | 1.4 |
| ML980007 | 3.9 | <2 | 280 | 7.2 | 18 | 51 | 2.3 |
| ML980008 | 3.8 | <2 | 200 | 6.8 | 11 | 20 | 1.3 |
| ML980009 | 1.5 | <2 | 190 | 5.6 | 13 | <20 | 0.7 |
| ML980010 | 2.9 | <2 | 150 | 5.3 | 11 | 40 | 0.7 |
| ML980011 | 2.7 | 3 | 240 | 5.9 | 10 | 48 | 0.8 |
| ML980012 | 4.2 | 3 | 170 | 4.6 | 15 | 58 | 1.2 |
| ML980013 | 4.9 | <2 | 140 | 5.3 | 15 | 87 | 0.7 |
| ML980014 | 2.7 | <2 | 110 | 6.6 | 9 | 31 | 0.6 |
| ML980015 | 2.7 | <2 | 220 | 3.9 | 22 | 68 | 1.0 |
| ML980016 | 2.2 | <2 | 120 | 7.8 | 7 | <20 | 0.6 |
| ML980017 | 2.2 | <2 | 110 | 6.0 | 8 | <20 | <0.5 |
| ML980018 | 2.5 | <2 | 150 | 5.3 | 8 | 32 | 1.1 |
| ML980019 | 3.8 | <2 | 210 | 5.7 | 17 | 74 | 1.0 |
| ML980020 | 5.9 | <2 | 290 | 3.8 | 19 | 120 | 1.0 |
| ML980021 | 3.1 | <2 | 99 | 8.4 | 6 | 21 | <0.5 |
| ML980022 | 3.0 | <2 | 160 | 5.5 | 7 | 25 | 0.7 |
| ML980023 | 10.0 | 2 | 210 | 4.1 | 23 | 120 | 1.4 |
| ML980024 | 2.6 | <2 | 180 | 7.2 | 10 | 32 | 0.8 |
| ML980025 | 3.6 | <2 | 150 | 8.5 | 15 | 45 | 0.6 |
| ML980026 | 5.2 | <2 | 130 | 18.0 | 69 | 32 | 0.8 |
| ML980027 | 2.6 | <2 | 150 | 7.3 | 7 | <20 | <0.5 |
| ML980028 | 4.3 | <2 | 430 | 6.1 | 17 | 45 | 1.0 |
| ML980029 | 5.9 | <2 | 220 | 5.1 | 21 | 100 | 1.1 |
| ML980030 | 3.8 | <2 | 190 | 6.5 | 12 | 76 | 1.0 |
| ML980031 | 3.0 | 2 | 220 | 6.9 | 10 | 56 | 0.7 |
| ML980032 | 3.6 | <2 | 150 | 7.1 | 11 | 50 | 0.6 |
| ML980033 | 4.7 | <2 | 340 | 7.8 | 13 | 63 | 0.9 |
| ML980034 | 7.1 | 3 | 200 | 6.0 | 23 | 110 | 1.7 |
| ML980035 | 3.9 | <2 | 180 | 5.1 | 12 | 53 | 0.9 |
| ML980036 | 3.2 | <2 | 170 | 6.5 | 11 | 83 | 0.6 |
| ML980037 | 12.0 | 6 | 200 | 10.0 | 23 | 59 | 1.3 |
| ML980038 | 5.8 | <2 | 64 | 17.0 | 14 | 46 | <0.5 |
| ML980039 | 3.7 | <2 | 560 | 6.2 | 15 | 57 | 0.9 |
| ML980040 | 3.7 | 3 | 95 | 12.0 | 6 | <20 | <0.5 |
| ML980041 | 6.3 | 3 | 440 | 8.7 | 20 | 74 | 1.5 |
| ML980042 | 3.8 | 3 | 310 | 16.0 | 13 | 25 | <0.5 |
| ML980043 | 4.8 | <2 | 390 | 6.2 | 21 | 160 | 1.5 |
| ML980044 | 2.6 | <2 | 160 | 6.6 | 10 | 47 | 0.6 |
| ML980045 | 4.2 | <2 | 180 | 11.0 | 29 | 84 | 1.9 |

## APPENDIX IV-iv: INAA Analysis - Humus

| Sample Number | As ppm INAA | Au ppb INAA | Ba ppm INAA | Br ppm INAA | Ce ppm INAA | Cr ppm INAA | Cs ppm INAA |
|---|---|---|---|---|---|---|---|
| ML980046 | 2.1 | <2 | 150 | 10.0 | 23 | 31 | 0.7 |
| ML980047 | 4.1 | <2 | 160 | 37.0 | 90 | 81 | 1.4 |
| ML980048 | 2.4 | <2 | 160 | 6.1 | 5 | <20 | <0.5 |
| ML980049 | 3.4 | <2 | 65 | 14.0 | <5 | <20 | <0.5 |
| ML980050 | 2.4 | <2 | 170 | 7.3 | 9 | 43 | <0.5 |
| ML980051 | 2.4 | <2 | 260 | 4.1 | 13 | 43 | 1.2 |
| ML980052 | 4.5 | <2 | 500 | 8.7 | 15 | 56 | 2.4 |
| ML980053 | 3.6 | <2 | 190 | 13.0 | 6 | <20 | <0.5 |
| ML980054 | 2.6 | <2 | 170 | 8.1 | 7 | <20 | 1.1 |
| ML980055 | 5.0 | <2 | 260 | 6.1 | 13 | 36 | 1.3 |
| ML980056 | 3.7 | <2 | 230 | 8.5 | 7 | 21 | 1.0 |
| ML980057 | 3.1 | 2 | 110 | 8.7 | 11 | 29 | 0.7 |
| ML980058 | 1.6 | <2 | 120 | 6.1 | 5 | <20 | 0.5 |
| ML980059 | 1.6 | <2 | 110 | 7.6 | <5 | <20 | 0.6 |
| ML980060 | 2.6 | <2 | 100 | 7.5 | 10 | <20 | 0.6 |
| ML980061 | 1.7 | <2 | 110 | 8.3 | 8 | <20 | <0.5 |
| ML980062 | 2.2 | <2 | 79 | 10.0 | <5 | <20 | <0.5 |
| ML980063 | 2.2 | <2 | 110 | 7.6 | 8 | <20 | <0.5 |
| ML980064 | 2.4 | <2 | 210 | 7.9 | 13 | 20 | 1.2 |
| ML980065 | 2.5 | <2 | 120 | 6.2 | 7 | <20 | 0.9 |
| ML980066 | 2.7 | <2 | 80 | 13.0 | <5 | <20 | <0.5 |
| ML980067 | 3.5 | 2 | 120 | 9.2 | 10 | <20 | 0.8 |
| ML980068 | 3.4 | <2 | 580 | 6.7 | 13 | 34 | 1.1 |
| ML980069 | 1.7 | <2 | 100 | 6.4 | <5 | <20 | <0.5 |
| ML980070 | 3.4 | <2 | 150 | 9.4 | 13 | <20 | 0.6 |
| ML980071 | 2.0 | <2 | 200 | 6.1 | 15 | 26 | 1.3 |
| ML980072 | 2.0 | <2 | 120 | 8.6 | 19 | <20 | 0.8 |
| ML980073 | 2.5 | <2 | 170 | 7.1 | 7 | <20 | <0.5 |
| ML980074 | 2.1 | 2 | 120 | 4.0 | 6 | <20 | 0.8 |
| ML980075 | 4.7 | <2 | 180 | 7.4 | 13 | 47 | 1.5 |
| ML980076 | 6.9 | <2 | 150 | 31.0 | 120 | 53 | 1.6 |
| ML980077 | 2.4 | 3 | 150 | 6.8 | 8 | <20 | 0.5 |
| ML980078 | 2.6 | <2 | 110 | 8.3 | <5 | <20 | <0.5 |
| ML980079 | 4.0 | 2 | 110 | 10.0 | 6 | <20 | <0.5 |
| ML980080 | 1.9 | <2 | 170 | 5.8 | 8 | 22 | <0.5 |
| ML980081 | 2.6 | <2 | 290 | 4.8 | 17 | 36 | 0.6 |
| ML980082 | 3.5 | 2 | 150 | 11.0 | 11 | <20 | 0.7 |
| ML980083 | 1.5 | <2 | 160 | 6.1 | <5 | <20 | <0.5 |
| ML980084 | 3.1 | <2 | 190 | 7.9 | <5 | <20 | <0.5 |
| ML980085 | 3.9 | <2 | 100 | 24.0 | 75 | 23 | 0.7 |
| ML980086 | 2.4 | <2 | 120 | 10.0 | 8 | <20 | 0.6 |
| ML980087 | 1.4 | <2 | 52 | 12.0 | <5 | <20 | <0.5 |
| ML980088 | 1.1 | <2 | 120 | 5.2 | <5 | <20 | <0.5 |
| ML980089 | 2.3 | <2 | 71 | 8.7 | <5 | <20 | <0.5 |
| ML980091 | 2.6 | <2 | 150 | 10.0 | 15 | 21 | 1.1 |

## APPENDIX IV-iv: INAA Analysis - Humus

| Sample Number | As ppm INAA | Au ppb INAA | Ba ppm INAA | Br ppm INAA | Ce ppm INAA | Cr ppm INAA | Cs ppm INAA |
|---|---|---|---|---|---|---|---|
| ML980092 | 4.9 | <2 | 330 | 5.2 | 19 | 43 | 1.0 |
| ML980093 | 5.1 | 6 | 140 | 9.3 | 14 | 30 | 0.6 |
| ML980094 | 2.1 | <2 | 240 | 8.4 | 7 | <20 | 0.7 |
| ML980095 | 3.3 | <2 | 100 | 6.6 | 9 | 21 | 0.7 |
| ML980096 | 2.7 | <2 | 260 | 9.0 | 18 | 25 | 0.9 |
| ML980097 | 2.5 | <2 | 130 | 11.0 | 13 | <20 | 0.8 |
| ML980098 | 2.2 | <2 | 190 | 5.8 | 11 | <20 | 0.7 |
| ML980099 | 2.1 | <2 | 100 | 9.0 | <5 | <20 | <0.5 |
| ML980100 | 1.6 | <2 | 78 | 6.8 | <5 | <20 | <0.5 |
| ML980101 | 2.4 | <2 | 90 | 13.0 | 44 | 30 | 1.1 |
| ML980102 | 2.4 | 2 | 95 | 7.1 | 6 | <20 | <0.5 |
| ML980103 | 3.0 | <2 | 190 | 8.5 | <5 | <20 | 0.5 |
| ML980104 | 2.2 | <2 | 120 | 10.0 | 6 | <20 | <0.5 |
| ML980105 | 3.4 | <2 | 160 | 9.1 | 10 | 27 | 0.6 |
| ML980106 | 2.0 | <2 | 110 | 11.0 | 9 | <20 | 0.5 |
| ML980107 | 0.8 | <2 | 160 | 4.5 | <5 | <20 | <0.5 |
| ML980108 | 13.0 | 4 | 230 | 4.8 | 23 | 81 | 1.5 |
| ML980109 | 1.5 | <2 | 310 | 4.5 | 18 | 54 | 1.2 |
| ML980110 | 2.9 | <2 | 70 | 10.0 | 8 | <20 | 0.5 |

## APPENDIX IV-iv: INAA Analysis - Humus

| Sample Number | Eu ppm INAA | Hf ppm INAA | Ir ppb INAA | La ppm INAA | Lu ppm INAA | Na % INAA | Rb ppm INAA |
|---|---|---|---|---|---|---|---|
| ML980001 | <1 | 1 | <50 | 5 | <0.2 | 0.12 | 16 |
| ML980002 | <1 | <1 | <50 | 4 | <0.2 | 0.16 | 19 |
| ML980003 | <1 | 2 | <50 | 6 | <0.2 | 0.14 | 19 |
| ML980004 | <1 | 4 | <50 | 13 | 0.3 | 0.34 | 25 |
| ML980005 | <1 | <1 | <50 | 2 | <0.2 | 0.07 | <5 |
| ML980006 | <1 | 1 | <50 | 6 | <0.2 | 0.29 | 23 |
| ML980007 | <1 | 3 | <50 | 8 | 0.2 | 0.28 | 35 |
| ML980008 | <1 | 2 | <50 | 6 | <0.2 | 0.13 | 18 |
| ML980009 | <1 | 3 | <50 | 8 | <0.2 | 0.68 | 10 |
| ML980010 | <1 | 1 | <50 | 5 | <0.2 | 0.15 | 15 |
| ML980011 | <1 | 1 | <50 | 6 | <0.2 | 0.14 | 17 |
| ML980012 | <1 | 2 | <50 | 8 | <0.2 | 0.31 | 27 |
| ML980013 | <1 | 2 | <50 | 9 | <0.2 | 0.31 | 21 |
| ML980014 | <1 | 1 | <50 | 5 | <0.2 | 0.17 | 13 |
| ML980015 | <1 | 6 | <50 | 13 | 0.3 | 0.49 | 29 |
| ML980016 | <1 | <1 | <50 | 3 | <0.2 | 0.07 | 10 |
| ML980017 | <1 | <1 | <50 | 4 | <0.2 | 0.10 | 8 |
| ML980018 | <1 | <1 | <50 | 3 | <0.2 | 0.11 | 22 |
| ML980019 | <1 | 3 | <50 | 8 | <0.2 | 0.25 | 24 |
| ML980020 | <1 | 4 | <50 | 12 | 0.2 | 0.35 | 26 |
| ML980021 | <1 | <1 | <50 | 3 | <0.2 | 0.12 | 14 |
| ML980022 | <1 | <1 | <50 | 5 | <0.2 | 0.15 | 10 |
| ML980023 | <1 | 2 | <50 | 12 | 0.3 | 0.51 | 37 |
| ML980024 | <1 | 1 | <50 | 5 | <0.2 | 0.15 | 9 |
| ML980025 | <1 | 1 | <50 | 8 | <0.2 | 0.17 | 10 |
| ML980026 | <1 | 1 | <50 | 34 | <0.2 | 0.11 | 14 |
| ML980027 | <1 | <1 | <50 | 4 | <0.2 | 0.14 | 8 |
| ML980028 | <1 | 4 | <50 | 8 | <0.2 | 0.21 | 32 |
| ML980029 | <1 | 3 | <50 | 11 | 0.2 | 0.38 | 31 |
| ML980030 | <1 | 1 | <50 | 7 | <0.2 | 0.20 | 24 |
| ML980031 | <1 | <1 | <50 | 5 | <0.2 | 0.16 | 18 |
| ML980032 | <1 | 2 | <50 | 6 | <0.2 | 0.18 | 9 |
| ML980033 | <1 | 2 | <50 | 7 | <0.2 | 0.23 | 19 |
| ML980034 | <1 | 2 | <50 | 13 | <0.2 | 0.49 | 34 |
| ML980035 | <1 | 1 | <50 | 7 | <0.2 | 0.20 | 18 |
| ML980036 | <1 | 1 | <50 | 7 | <0.2 | 0.27 | 18 |
| ML980037 | <1 | <1 | <50 | 10 | <0.2 | 0.15 | 22 |
| ML980038 | <1 | <1 | <50 | 10 | <0.2 | 0.11 | 5 |
| ML980039 | <1 | 2 | <50 | 9 | <0.2 | 0.21 | 19 |
| ML980040 | <1 | <1 | <50 | 4 | <0.2 | 0.09 | 10 |
| ML980041 | <1 | 2 | <50 | 12 | <0.2 | 0.34 | 23 |
| ML980042 | <1 | <1 | <50 | 13 | <0.2 | 0.09 | <5 |
| ML980043 | <1 | 3 | <50 | 12 | <0.2 | 0.49 | 38 |
| ML980044 | <1 | 2 | <50 | 5 | <0.2 | 0.17 | 13 |
| ML980045 | <1 | 3 | <50 | 19 | 0.3 | 0.42 | 63 |

## APPENDIX IV-iv: INAA Analysis - Humus

| Sample Number | Eu ppm INAA | Hf ppm INAA | Ir ppb INAA | La ppm INAA | Lu ppm INAA | Na % INAA | Rb ppm INAA |
|---|---|---|---|---|---|---|---|
| ML980046 | 1 | 1 | <50 | 13 | <0.2 | 0.16 | 9 |
| ML980047 | 2 | 2 | <50 | 44 | 0.5 | 0.27 | 30 |
| ML980048 | <1 | <1 | <50 | 3 | <0.2 | 0.13 | 11 |
| ML980049 | <1 | <1 | <50 | 4 | <0.2 | 0.03 | <5 |
| ML980050 | <1 | 2 | <50 | 5 | <0.2 | 0.18 | 11 |
| ML980051 | <1 | 4 | <50 | 6 | 0.3 | 0.41 | 29 |
| ML980052 | <1 | 3 | <50 | 8 | 0.3 | 0.31 | 49 |
| ML980053 | <1 | <1 | <50 | 3 | <0.2 | 0.05 | <5 |
| ML980054 | <1 | 1 | <50 | 3 | <0.2 | 0.11 | 19 |
| ML980055 | <1 | 4 | <50 | 6 | 0.3 | 0.36 | 31 |
| ML980056 | <1 | <1 | <50 | 5 | <0.2 | 0.15 | 16 |
| ML980057 | <1 | 2 | <50 | 6 | <0.2 | 0.16 | 10 |
| ML980058 | <1 | <1 | <50 | 3 | <0.2 | 0.09 | 9 |
| ML980059 | <1 | <1 | <50 | 2 | <0.2 | 0.07 | 11 |
| ML980060 | <1 | 2 | <50 | 5 | <0.2 | 0.11 | 10 |
| ML980061 | <1 | <1 | <50 | 4 | <0.2 | 0.10 | 10 |
| ML980062 | <1 | <1 | <50 | <2 | <0.2 | 0.03 | <5 |
| ML980063 | <1 | <1 | <50 | 3 | <0.2 | 0.08 | 9 |
| ML980064 | <1 | 2 | <50 | 7 | <0.2 | 0.15 | 16 |
| ML980065 | <1 | <1 | <50 | 4 | <0.2 | 0.17 | 17 |
| ML980066 | <1 | <1 | <50 | 3 | <0.2 | 0.06 | <5 |
| ML980067 | <1 | 1 | <50 | 5 | <0.2 | 0.23 | 21 |
| ML980068 | <1 | 5 | <50 | 6 | 0.3 | 0.26 | 48 |
| ML980069 | <1 | <1 | <50 | <2 | <0.2 | 0.11 | 6 |
| ML980070 | <1 | 1 | <50 | 6 | <0.2 | 0.17 | 14 |
| ML980071 | <1 | 3 | <50 | 7 | <0.2 | 0.50 | 17 |
| ML980072 | <1 | <1 | <50 | 14 | <0.2 | 0.15 | 12 |
| ML980073 | <1 | 3 | <50 | 4 | <0.2 | 0.42 | 14 |
| ML980074 | <1 | <1 | <50 | 4 | <0.2 | 0.13 | 13 |
| ML980075 | <1 | 2 | <50 | 8 | <0.2 | 0.25 | 32 |
| ML980076 | 8 | 1 | <50 | 140 | 1.4 | 0.30 | 24 |
| ML980077 | <1 | 1 | <50 | 4 | <0.2 | 0.15 | 15 |
| ML980078 | <1 | <1 | <50 | 2 | <0.2 | 0.07 | 9 |
| ML980079 | <1 | <1 | <50 | 3 | <0.2 | 0.12 | 9 |
| ML980080 | <1 | 2 | <50 | 4 | <0.2 | 0.25 | 16 |
| ML980081 | <1 | 4 | <50 | 9 | <0.2 | 0.57 | 22 |
| ML980082 | <1 | <1 | <50 | 7 | <0.2 | 0.15 | 12 |
| ML980083 | <1 | <1 | <50 | 2 | <0.2 | 0.07 | 11 |
| ML980084 | <1 | 1 | <50 | 4 | <0.2 | 0.14 | 10 |
| ML980085 | 1 | <1 | <50 | 67 | 0.3 | 0.07 | 10 |
| ML980086 | <1 | 2 | <50 | 5 | <0.2 | 0.27 | 13 |
| ML980087 | <1 | <1 | <50 | <2 | <0.2 | 0.04 | 7 |
| ML980088 | <1 | <1 | <50 | <2 | <0.2 | 0.12 | 15 |
| ML980089 | <1 | <1 | <50 | <2 | <0.2 | 0.06 | 8 |
| ML980091 | <1 | 1 | <50 | 10 | <0.2 | 0.24 | 19 |

## APPENDIX IV-iv: INAA Analysis - Humus

| Sample Number | Eu ppm INAA | Hf ppm INAA | Ir ppb INAA | La ppm INAA | Lu ppm INAA | Na % INAA | Rb ppm INAA |
|---|---|---|---|---|---|---|---|
| ML980092 | <1 | 3 | <50 | 9 | <0.2 | 0.71 | 36 |
| ML980093 | <1 | 2 | <50 | 6 | <0.2 | 0.18 | 11 |
| ML980094 | <1 | <1 | <50 | 4 | <0.2 | 0.09 | 10 |
| ML980095 | <1 | 2 | <50 | 5 | <0.2 | 0.25 | 12 |
| ML980096 | <1 | 2 | <50 | 10 | <0.2 | 0.31 | 21 |
| ML980097 | <1 | <1 | <50 | 7 | <0.2 | 0.12 | 23 |
| ML980098 | <1 | 1 | <50 | 6 | <0.2 | 0.20 | 15 |
| ML980099 | <1 | <1 | <50 | 3 | <0.2 | 0.08 | 11 |
| ML980100 | <1 | <1 | <50 | <2 | <0.2 | 0.03 | <5 |
| ML980101 | 2 | 1 | <50 | 39 | 0.3 | 0.20 | 19 |
| ML980102 | <1 | <1 | <50 | 3 | <0.2 | 0.13 | 11 |
| ML980103 | <1 | <1 | <50 | 3 | <0.2 | 0.14 | 15 |
| ML980104 | <1 | <1 | <50 | 3 | <0.2 | 0.11 | 13 |
| ML980105 | <1 | 2 | <50 | 6 | <0.2 | 0.26 | 13 |
| ML980106 | <1 | <1 | <50 | 5 | <0.2 | 0.12 | 14 |
| ML980107 | <1 | <1 | <50 | 2 | <0.2 | 0.08 | 10 |
| ML980108 | <1 | 2 | <50 | 13 | 0.3 | 0.49 | 32 |
| ML980109 | <1 | 2 | <50 | 11 | <0.2 | 0.35 | 29 |
| ML980110 | <1 | <1 | <50 | 3 | <0.2 | 0.13 | 7 |

## APPENDIX IV-iv: INAA Analysis - Humus

| Sample Number | Sb ppm INAA | Sc ppm INAA | Se ppm INAA | Sm ppm INAA | Sn ppm INAA | Ta ppm INAA | Tb ppm INAA |
|---|---|---|---|---|---|---|---|
| ML980001 | 0.6 | 1.5 | <5 | 0.5 | <100 | <0.5 | <0.5 |
| ML980002 | 0.6 | 1.7 | <5 | 0.5 | <100 | <0.5 | <0.5 |
| ML980003 | 0.9 | 1.9 | <5 | 0.7 | <100 | <0.5 | <0.5 |
| ML980004 | 0.8 | 3.6 | <5 | 1.5 | <100 | <0.5 | <0.5 |
| ML980005 | 0.2 | 0.7 | <5 | 0.2 | <100 | <0.5 | <0.5 |
| ML980006 | 0.7 | 2.8 | <5 | 0.8 | <100 | <0.5 | <0.5 |
| ML980007 | 0.8 | 3.7 | <5 | 1.1 | <100 | <0.5 | <0.5 |
| ML980008 | 1.1 | 3.4 | <5 | 0.9 | <100 | <0.5 | <0.5 |
| ML980009 | 0.8 | 2.0 | <5 | 0.7 | <100 | <0.5 | <0.5 |
| ML980010 | 0.8 | 2.0 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980011 | 0.8 | 2.0 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980012 | 0.9 | 3.7 | <5 | 1.0 | <100 | <0.5 | <0.5 |
| ML980013 | 1.0 | 3.3 | <5 | 1.0 | <100 | <0.5 | <0.5 |
| ML980014 | 0.9 | 2.0 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980015 | 0.8 | 3.8 | <5 | 1.5 | <100 | <0.5 | <0.5 |
| ML980016 | 1.0 | 1.0 | <5 | 0.3 | <100 | <0.5 | <0.5 |
| ML980017 | 0.8 | 1.4 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980018 | 0.7 | 1.2 | <5 | 0.5 | <100 | <0.5 | <0.5 |
| ML980019 | 0.9 | 3.0 | <5 | 1.0 | <100 | <0.5 | <0.5 |
| ML980020 | 0.9 | 4.4 | <5 | 1.5 | <100 | <0.5 | <0.5 |
| ML980021 | 0.9 | 1.4 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980022 | 0.6 | 1.8 | <5 | 0.5 | <100 | <0.5 | <0.5 |
| ML980023 | 1.1 | 6.7 | <5 | 1.5 | <100 | <0.5 | <0.5 |
| ML980024 | 1.0 | 2.0 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980025 | 1.3 | 2.4 | <5 | 1.1 | <100 | <0.5 | <0.5 |
| ML980026 | 0.9 | 3.4 | <5 | 4.2 | <100 | <0.5 | <0.5 |
| ML980027 | 1.1 | 1.5 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980028 | 1.1 | 3.5 | <5 | 1.2 | <100 | 0.6 | <0.5 |
| ML980029 | 1.1 | 4.8 | <5 | 1.4 | <100 | <0.5 | <0.5 |
| ML980030 | 0.8 | 2.9 | <5 | 0.9 | <100 | <0.5 | <0.5 |
| ML980031 | 0.9 | 2.0 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980032 | 1.0 | 2.2 | <5 | 0.7 | <100 | <0.5 | <0.5 |
| ML980033 | 1.1 | 2.6 | <5 | 0.7 | <100 | <0.5 | <0.5 |
| ML980034 | 1.0 | 5.7 | <5 | 1.6 | <100 | <0.5 | <0.5 |
| ML980035 | 0.6 | 2.6 | <5 | 0.8 | <100 | <0.5 | <0.5 |
| ML980036 | 0.5 | 2.7 | <5 | 0.7 | <100 | <0.5 | <0.5 |
| ML980037 | 1.1 | 5.2 | <5 | 1.6 | <100 | <0.5 | <0.5 |
| ML980038 | 1.1 | 2.4 | <5 | 1.6 | <100 | <0.5 | <0.5 |
| ML980039 | 1.1 | 2.4 | <5 | 1.1 | <100 | <0.5 | <0.5 |
| ML980040 | 0.9 | 1.1 | <5 | 0.5 | <100 | <0.5 | <0.5 |
| ML980041 | 1.3 | 5.0 | <5 | 1.4 | <100 | <0.5 | <0.5 |
| ML980042 | 0.9 | 4.8 | <5 | 2.1 | <100 | <0.5 | <0.5 |
| ML980043 | 1.0 | 5.6 | <5 | 1.4 | <100 | <0.5 | <0.5 |
| ML980044 | 0.8 | 1.9 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980045 | 0.8 | 5.8 | <5 | 2.5 | <100 | <0.5 | <0.5 |

## APPENDIX IV-iv: INAA Analysis - Humus

| Sample Number | Sb ppm INAA | Sc ppm INAA | Se ppm INAA | Sm ppm INAA | Sn ppm INAA | Ta ppm INAA | Tb ppm INAA |
|---|---|---|---|---|---|---|---|
| ML980046 | 0.6 | 2.2 | <5 | 1.7 | <100 | <0.5 | <0.5 |
| ML980047 | 1.0 | 6.0 | <5 | 7.5 | <100 | <0.5 | 0.8 |
| ML980048 | 0.4 | 1.4 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980049 | 0.9 | 0.4 | <5 | 0.3 | <100 | <0.5 | <0.5 |
| ML980050 | 0.7 | 1.6 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980051 | 0.5 | 7.5 | <5 | 1.4 | <100 | 0.6 | <0.5 |
| ML980052 | 1.1 | 5.9 | <5 | 1.1 | <100 | <0.5 | <0.5 |
| ML980053 | 0.7 | 0.7 | <5 | 0.3 | <100 | <0.5 | <0.5 |
| ML980054 | 1.1 | 2.0 | <5 | 0.5 | <100 | <0.5 | <0.5 |
| ML980055 | 0.6 | 6.1 | <5 | 1.0 | <100 | 0.5 | <0.5 |
| ML980056 | 1.0 | 1.9 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980057 | 0.9 | 2.2 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980058 | 0.6 | 1.2 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980059 | 1.0 | 0.8 | <5 | 0.3 | <100 | <0.5 | <0.5 |
| ML980060 | 1.1 | 1.7 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980061 | 1.0 | 1.1 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980062 | 0.6 | 0.4 | <5 | 0.2 | <100 | <0.5 | <0.5 |
| ML980063 | 0.9 | 1.0 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980064 | 0.9 | 1.9 | <5 | 0.9 | <100 | <0.5 | <0.5 |
| ML980065 | 0.9 | 1.5 | <5 | 0.5 | <100 | <0.5 | <0.5 |
| ML980066 | 0.4 | 0.8 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980067 | 1.1 | 2.1 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980068 | 1.0 | 5.6 | <5 | 0.9 | <100 | 0.6 | <0.5 |
| ML980069 | 0.8 | 0.7 | <5 | 0.3 | <100 | <0.5 | <0.5 |
| ML980070 | 1.4 | 1.4 | <5 | 0.8 | <100 | <0.5 | <0.5 |
| ML980071 | 1.0 | 2.4 | <5 | 0.8 | <100 | <0.5 | <0.5 |
| ML980072 | 0.7 | 1.8 | <5 | 1.4 | <100 | <0.5 | <0.5 |
| ML980073 | 0.8 | 1.5 | <5 | 0.5 | <100 | <0.5 | <0.5 |
| ML980074 | 0.9 | 1.7 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980075 | 0.9 | 3.8 | <5 | 0.8 | <100 | <0.5 | <0.5 |
| ML980076 | 1.2 | 8.4 | <5 | 25.8 | <100 | <0.5 | 3.1 |
| ML980077 | 1.1 | 1.2 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980078 | 1.1 | 0.8 | <5 | 0.3 | <100 | <0.5 | <0.5 |
| ML980079 | 1.2 | 1.1 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980080 | 0.5 | 1.7 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980081 | 0.6 | 2.6 | <5 | 1.1 | <100 | 0.6 | <0.5 |
| ML980082 | 1.1 | 2.0 | <5 | 1.0 | <100 | <0.5 | <0.5 |
| ML980083 | 0.8 | 1.0 | <5 | 0.3 | <100 | <0.5 | <0.5 |
| ML980084 | 1.3 | 1.2 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980085 | 0.9 | 3.7 | <5 | 7.5 | <100 | <0.5 | 0.8 |
| ML980086 | 0.6 | 1.5 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980087 | 0.5 | 0.6 | <5 | 0.3 | <100 | <0.5 | <0.5 |
| ML980088 | 0.4 | 0.7 | <5 | 0.2 | <100 | <0.5 | <0.5 |
| ML980089 | 0.8 | 0.6 | <5 | 0.2 | <100 | <0.5 | <0.5 |
| ML980091 | 0.9 | 2.2 | <5 | 1.1 | <100 | <0.5 | <0.5 |

## APPENDIX IV-iv: INAA Analysis - Humus

| Sample Number | Sb ppm INAA | Sc ppm INAA | Se ppm INAA | Sm ppm INAA | Sn ppm INAA | Ta ppm INAA | Tb ppm INAA |
|---|---|---|---|---|---|---|---|
| ML980092 | 1.2 | 4.4 | <5 | 1.2 | <100 | <0.5 | <0.5 |
| ML980093 | 1.3 | 2.1 | <5 | 0.8 | <100 | <0.5 | <0.5 |
| ML980094 | 0.8 | 0.9 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980095 | 1.5 | 1.4 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980096 | 1.0 | 2.5 | <5 | 1.1 | <100 | <0.5 | <0.5 |
| ML980097 | 0.9 | 2.2 | <5 | 0.8 | <100 | <0.5 | <0.5 |
| ML980098 | 0.8 | 1.7 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980099 | 0.7 | 0.8 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980100 | 0.4 | 0.4 | <5 | 0.2 | <100 | <0.5 | <0.5 |
| ML980101 | 1.0 | 4.5 | <5 | 5.4 | <100 | <0.5 | <0.5 |
| ML980102 | 0.9 | 1.2 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980103 | 1.0 | 1.2 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980104 | 1.1 | 1.1 | <5 | 0.4 | <100 | <0.5 | <0.5 |
| ML980105 | 0.9 | 2.0 | <5 | 0.7 | <100 | <0.5 | <0.5 |
| ML980106 | 0.8 | 1.4 | <5 | 0.6 | <100 | <0.5 | <0.5 |
| ML980107 | 0.4 | 0.8 | <5 | 0.3 | <100 | <0.5 | <0.5 |
| ML980108 | 1.6 | 6.4 | <5 | 1.7 | <100 | <0.5 | <0.5 |
| ML980109 | 0.6 | 3.5 | <5 | 1.0 | <100 | <0.5 | <0.5 |
| ML980110 | 1.1 | 4.7 | <5 | 0.8 | <100 | <0.5 | <0.5 |

## APPENDIX IV-iv: INAA Analysis - Humus

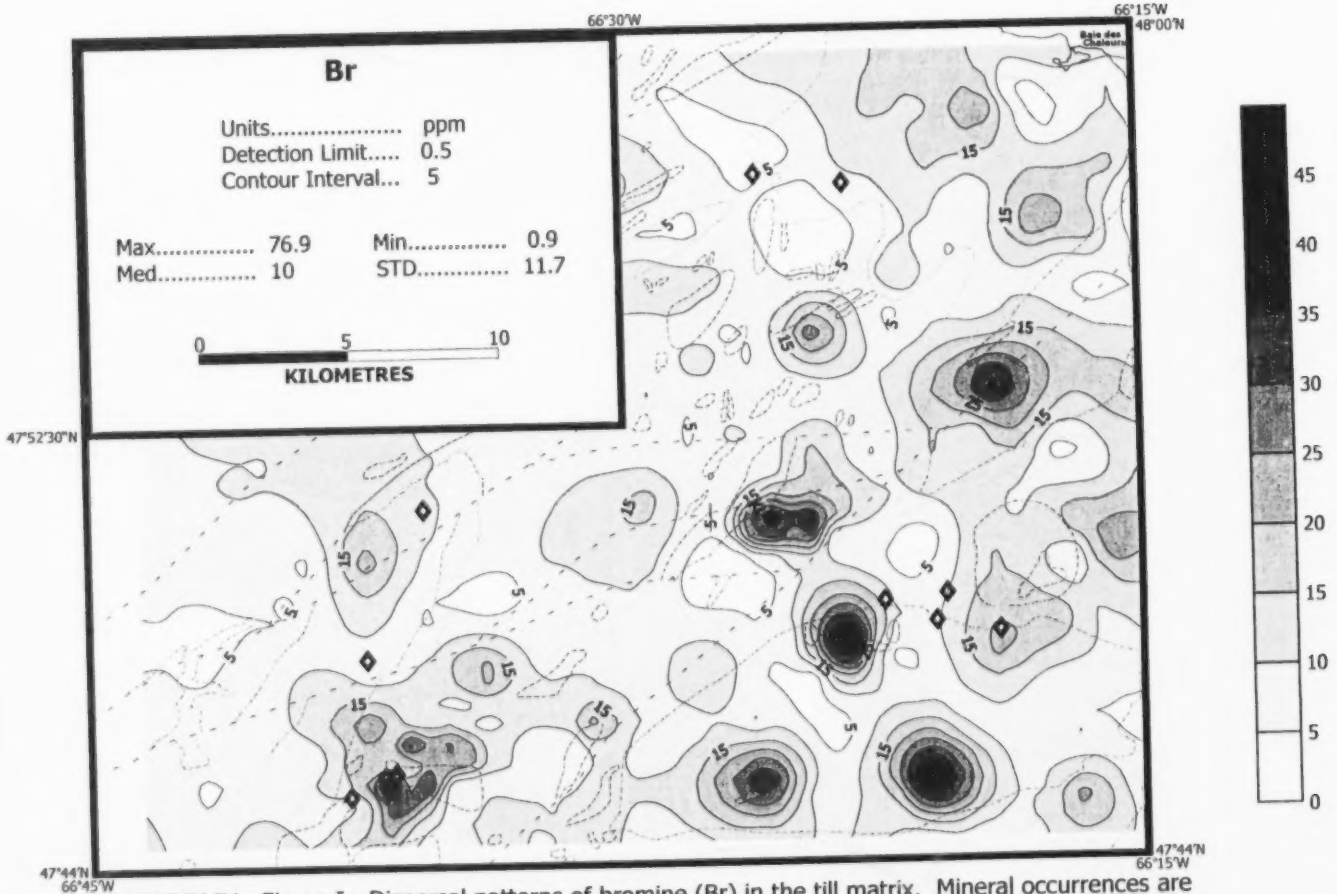
| Sample Number | Te ppm INAA | Th ppm INAA | U ppm INAA | W ppm INAA | Yb ppm INAA | Zr ppm INAA |
|---|---|---|---|---|---|---|
| ML980001 | <10 | 1.0 | 0.5 | <1 | <1 | <200 |
| ML980002 | <10 | 1.0 | 0.4 | <1 | <1 | <200 |
| ML980003 | <10 | 1.3 | 0.6 | <1 | <1 | <200 |
| ML980004 | <10 | 2.8 | 1.0 | 1 | <1 | <200 |
| ML980005 | <10 | 0.5 | 0.2 | <1 | <1 | <200 |
| ML980006 | <10 | 1.5 | 0.8 | <1 | <1 | <200 |
| ML980007 | <10 | 2.5 | 1.0 | <1 | <1 | <200 |
| ML980008 | <10 | 1.7 | 0.8 | 1 | 1 | <200 |
| ML980009 | <10 | 1.8 | 0.9 | <1 | <1 | <200 |
| ML980010 | <10 | 1.3 | 0.5 | <1 | <1 | <200 |
| ML980011 | <10 | 1.1 | 0.5 | <1 | <1 | <200 |
| ML980012 | <10 | 2.1 | 0.8 | <1 | <1 | <200 |
| ML980013 | <10 | 1.7 | 0.8 | <1 | <1 | <200 |
| ML980014 | <10 | 1.1 | 0.4 | <1 | <1 | <200 |
| ML980015 | <10 | 3.3 | 1.2 | <1 | <1 | 210 |
| ML980016 | <10 | 0.7 | 0.3 | 1 | <1 | <200 |
| ML980017 | <10 | 0.9 | 0.3 | <1 | <1 | <200 |
| ML980018 | <10 | 0.9 | 0.4 | <1 | <1 | <200 |
| ML980019 | <10 | 1.9 | 0.8 | <1 | <1 | <200 |
| ML980020 | <10 | 2.7 | 1.3 | <1 | <1 | <200 |
| ML980021 | <10 | 0.8 | 0.4 | <1 | <1 | <200 |
| ML980022 | <10 | 0.9 | 0.3 | <1 | <1 | <200 |
| ML980023 | <10 | 2.9 | 1.5 | <1 | <1 | <200 |
| ML980024 | <10 | 1.0 | 0.4 | <1 | <1 | <200 |
| ML980025 | <10 | 1.3 | 0.4 | <1 | <1 | <200 |
| ML980026 | <10 | 1.6 | 0.6 | <1 | <1 | <200 |
| ML980027 | <10 | 0.7 | 0.3 | <1 | <1 | <200 |
| ML980028 | <10 | 2.9 | 1.2 | <1 | <1 | <200 |
| ML980029 | <10 | 2.6 | 1.2 | <1 | <1 | <200 |
| ML980030 | <10 | 1.5 | 0.5 | <1 | <1 | <200 |
| ML980031 | <10 | 1.3 | 0.5 | <1 | <1 | <200 |
| ML980032 | <10 | 1.2 | 0.5 | <1 | <1 | <200 |
| ML980033 | <10 | 1.8 | 0.7 | <1 | <1 | <200 |
| ML980034 | <10 | 3.1 | 1.5 | <1 | 1 | <200 |
| ML980035 | <10 | 1.4 | 0.6 | <1 | <1 | <200 |
| ML980036 | <10 | 1.4 | 0.5 | <1 | <1 | <200 |
| ML980037 | <10 | 1.7 | 0.6 | <1 | <1 | <200 |
| ML980038 | <10 | 1.1 | 0.4 | <1 | <1 | <200 |
| ML980039 | <10 | 2.0 | 0.8 | <1 | <1 | <200 |
| ML980040 | <10 | 0.6 | 0.2 | <1 | <1 | <200 |
| ML980041 | <10 | 2.5 | 1.1 | <1 | <1 | <200 |
| ML980042 | <10 | 1.0 | 0.9 | <1 | <1 | <200 |
| ML980043 | <10 | 2.8 | 0.9 | <1 | <1 | <200 |
| ML980044 | <10 | 1.2 | 0.5 | <1 | <1 | <200 |
| ML980045 | <10 | 3.3 | 1.4 | <1 | <1 | <200 |

## APPENDIX IV-iv: INAA Analysis - Humus

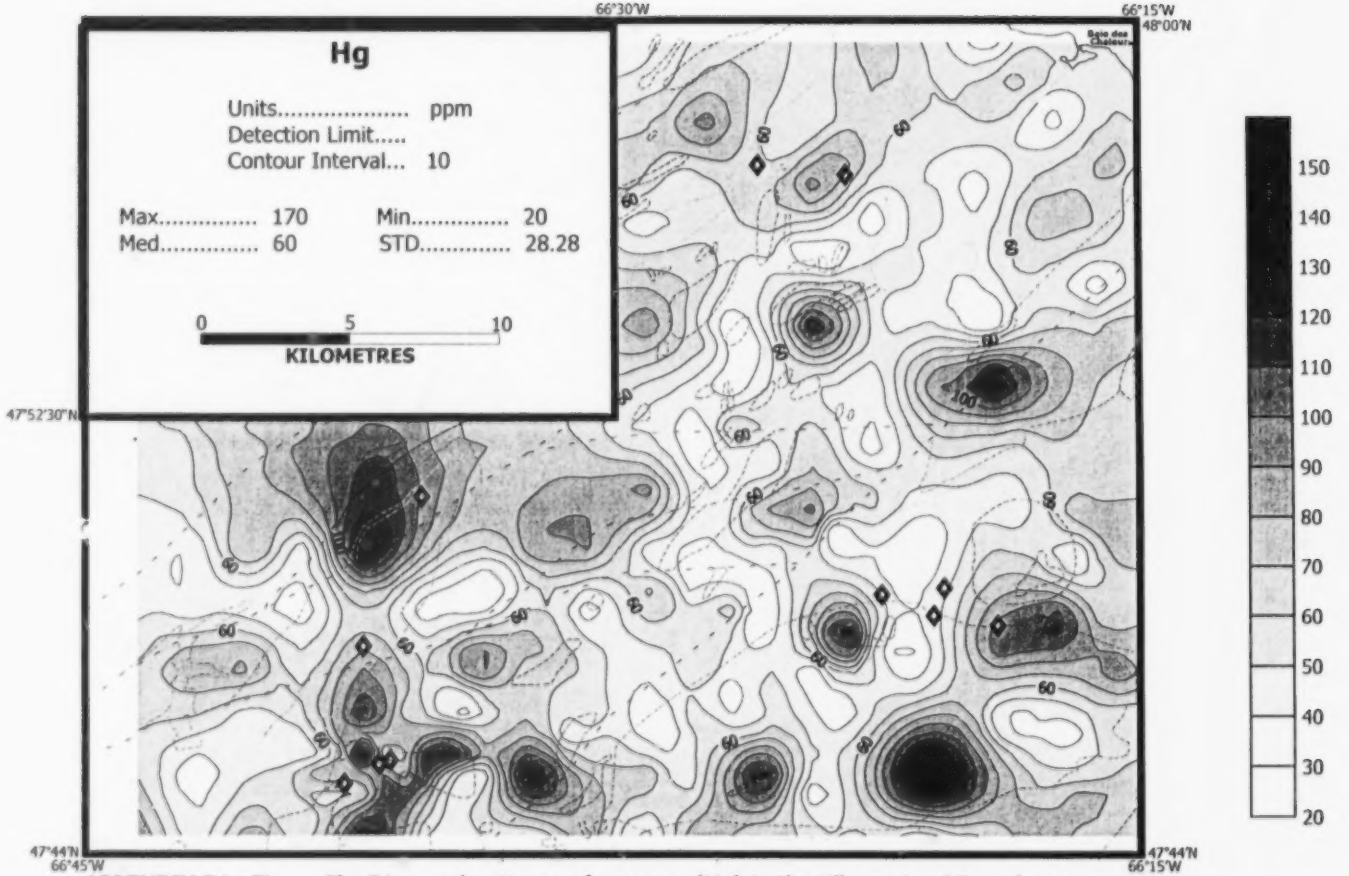
| Sample Number | Te ppm INAA | Th ppm INAA | U ppm INAA | W ppm INAA | Yb ppm INAA | Zr ppm INAA |
|---|---|---|---|---|---|---|
| ML980046 | <10 | 1.1 | 0.5 | <1 | <1 | <200 |
| ML980047 | <10 | 3.0 | 1.1 | <1 | 2 | <200 |
| ML980048 | <10 | 0.8 | 0.5 | <1 | <1 | <200 |
| ML980049 | <10 | 0.4 | <0.2 | <1 | <1 | <200 |
| ML980050 | <10 | 1.1 | 0.5 | <1 | <1 | <200 |
| ML980051 | <10 | 1.9 | 1.1 | 2 | 1 | <200 |
| ML980052 | <10 | 2.2 | 1.0 | 2 | 1 | <200 |
| ML980053 | <10 | 0.4 | 0.2 | <1 | <1 | <200 |
| ML980054 | <10 | 1.0 | 0.5 | <1 | <1 | <200 |
| ML980055 | <10 | 1.9 | 1.3 | 1 | <1 | <200 |
| ML980056 | <10 | 1.1 | 0.4 | <1 | <1 | <200 |
| ML980057 | <10 | 1.3 | 0.4 | <1 | <1 | <200 |
| ML980058 | <10 | 0.7 | 0.3 | <1 | <1 | <200 |
| ML980059 | <10 | 0.7 | <0.2 | <1 | <1 | <200 |
| ML980060 | <10 | 1.0 | 0.4 | <1 | <1 | <200 |
| ML980061 | <10 | 0.6 | 0.3 | <1 | <1 | <200 |
| ML980062 | <10 | 0.3 | <0.2 | <1 | <1 | <200 |
| ML980063 | <10 | 0.7 | <0.2 | <1 | <1 | <200 |
| ML980064 | <10 | 1.7 | 0.6 | <1 | <1 | <200 |
| ML980065 | <10 | 0.9 | 0.4 | <1 | <1 | <200 |
| ML980066 | <10 | 0.4 | 0.2 | <1 | <1 | <200 |
| ML980067 | <10 | 1.1 | 0.6 | 2 | <1 | <200 |
| ML980068 | <10 | 2.5 | 1.5 | 20 | 1 | <200 |
| ML980069 | <10 | 0.4 | <0.2 | <1 | <1 | <200 |
| ML980070 | <10 | 1.6 | 0.6 | <1 | <1 | <200 |
| ML980071 | <10 | 1.7 | 0.7 | <1 | <1 | 220 |
| ML980072 | <10 | 0.8 | 0.3 | <1 | <1 | <200 |
| ML980073 | <10 | 1.1 | 0.5 | 1 | <1 | <200 |
| ML980074 | <10 | 0.9 | 0.4 | <1 | <1 | <200 |
| ML980075 | <10 | 1.8 | 0.8 | <1 | <1 | <200 |
| ML980076 | <10 | 2.3 | 2.6 | 3 | 6 | <200 |
| ML980077 | <10 | 0.8 | 0.3 | <1 | <1 | <200 |
| ML980078 | <10 | 0.6 | 0.2 | <1 | <1 | <200 |
| ML980079 | <10 | 0.7 | 0.4 | 1 | <1 | <200 |
| ML980080 | <10 | 1.1 | 0.5 | 2 | <1 | <200 |
| ML980081 | <10 | 2.4 | 1.0 | 2 | <1 | <200 |
| ML980082 | <10 | 1.1 | 0.4 | <1 | <1 | <200 |
| ML980083 | <10 | 0.6 | 0.3 | <1 | <1 | <200 |
| ML980084 | <10 | 1.0 | 0.5 | 1 | <1 | <200 |
| ML980085 | <10 | 1.6 | 1.2 | 4 | 2 | <200 |
| ML980086 | <10 | 1.3 | 0.5 | 3 | <1 | <200 |
| ML980087 | <10 | 0.3 | <0.2 | <1 | <1 | <200 |
| ML980088 | <10 | 0.3 | <0.2 | <1 | <1 | <200 |
| ML980089 | <10 | 0.4 | <0.2 | <1 | <1 | <200 |
| ML980091 | <10 | 1.3 | 0.5 | <1 | <1 | <200 |

## APPENDIX IV-iv: INAA Analysis - Humus

| Sample Number | Te ppm INAA | Th ppm INAA | U ppm INAA | W ppm INAA | Yb ppm INAA | Zr ppm INAA |
|---|---|---|---|---|---|---|
| ML980092 | <10 | 2.3 | 1.4 | <1 | <1 | 250 |
| ML980093 | <10 | 1.7 | 0.6 | <1 | <1 | <200 |
| ML980094 | <10 | 0.8 | 0.3 | <1 | <1 | <200 |
| ML980095 | <10 | 1.2 | 0.4 | <1 | <1 | <200 |
| ML980096 | <10 | 1.9 | 0.7 | 2 | <1 | <200 |
| ML980097 | <10 | 1.1 | 0.4 | <1 | <1 | <200 |
| ML980098 | <10 | 0.9 | 0.3 | 1 | <1 | <200 |
| ML980099 | <10 | 0.3 | <0.2 | <1 | <1 | <200 |
| ML980100 | <10 | 0.3 | <0.2 | <1 | <1 | <200 |
| ML980101 | <10 | 1.6 | 1.2 | <1 | 2 | <200 |
| ML980102 | <10 | 0.8 | 0.3 | <1 | <1 | <200 |
| ML980103 | <10 | 0.9 | 0.4 | <1 | <1 | <200 |
| ML980104 | <10 | 0.7 | 0.2 | <1 | <1 | <200 |
| ML980105 | <10 | 1.6 | 0.7 | <1 | <1 | <200 |
| ML980106 | <10 | 0.8 | 0.3 | <1 | <1 | <200 |
| ML980107 | <10 | 0.4 | <0.2 | <1 | <1 | <200 |
| ML980108 | <10 | 3.0 | 1.4 | <1 | 1 | 220 |
| ML980109 | <10 | 2.1 | 0.8 | <1 | <1 | <200 |
| ML980110 | <10 | 0.5 | 0.3 | <1 | <1 | <200 |




APPENDIX IV - Figure I: Dispersal patterns of bromine (Br) in the till matrix. Mineral occurrences are indicated by the diamond shape (from Figure 3.3) and bedrock units are outlined by dashed lines (from Figure 3.2).




APPENDIX IV - Figure II: Dispersal patterns of mercury (Hg) in the till matrix. Mineral occurrences are indicated by the diamond shape (from Figure 3.3) and bedrock units are outlined by dashed lines (from Figure 3.2).

# APPENDIX V

## STANDARDS AND DUPLICATES

Accuracy of the analytical procedures was evaluated using four reference standards (LKSD-4, Till-1, Till-2, and Till-3). These standards were analyzed, at random, along with the field sample; and the results were compared to DNRE accepted values (Table I - IV). Analytical error was calculated using the relative standard deviation (RSD):

$$\textbf{RSD (\%)} = \left(\frac{\textbf{STD}}{\textbf{AVG}}\right) \textbf{100}$$

**where: STD = standard deviation**
**AVG = average of standard analyses**

Eleven field duplicates were collected, at random, from approximately the same depth in the C-horizon to evaluate the local geochemical variability of the till matrix (Table V and VI). Variability within the sample was measured by preparing thirteen random sample splits (Table VII - VIII). Analytical error of duplicate analyses was calculated as:

$$\textbf{RSD (\%)} = \left(\frac{\textbf{D}/\sqrt{\textbf{2}}}{\textbf{AVG}}\right) \textbf{100}$$

**where: D = difference between duplicate analyses**

The correlation between sample and duplicate was determined using simple linear regression analysis in Corel® Quattro Pro (Figure I and II).

APPENDIX V: Table I - Analytical Values of Geochemical Standards - AAS

| AAS Experimental Values | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Element | | | Ag | Cd | Co | Cu | Fe | Mn | Mo | Ni | Pb | V | Zn | Hg |
| Units | | | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppb |
| STANDARDS | LKSD-4 | Run 1 | 0.2 | 1.7 | 10 | 32 | 2.9 | 430 | 2 | 28 | 93 | 35 | 191 | 170 |
| | | Run 2 | 0.2 | 1.7 | 10 | 32 | 2.7 | 435 | 2 | 29 | 94 | 35 | 195 | 190 |
| | | Run 3 | 0.2 | 1.6 | 10 | 30 | 2.7 | 425 | 2 | 28 | 89 | 34 | 192 | 170 |
| | | Run 4 | 0.2 | 1.9 | 8 | 32 | 2.8 | 420 | 2 | 30 | 90 | 30 | 195 | 160 |
| | | Run 5 | 0.2 | 1.9 | 9 | 32 | 2.8 | 420 | 2 | 30 | 95 | 34 | 193 | 170 |
| | | Run 6 | 0.2 | 2.0 | 11 | 32 | 2.7 | 420 | 2 | 32 | 93 | 37 | 194 | 180 |
| | | Run 7 | 0.2 | 1.8 | 10 | 31 | 2.6 | 410 | 2 | 31 | 94 | 34 | 192 | 190 |
| | | Run 8 | 0.3 | 1.8 | 11 | 31 | 2.7 | 415 | 3 | 32 | 95 | 34 | 193 | 180 |
| | | Run 9 | 0.2 | 1.9 | 11 | 32 | 2.8 | 410 | 2 | 31 | 93 | 35 | 193 | 180 |
| | | Run 10 | 0.3 | 1.8 | 11 | 33 | 2.6 | 420 | 2 | 31 | 95 | 36 | 192 | 180 |
| | | Run 11 | 0.3 | 1.9 | 10 | 31 | 2.6 | 417 | 2 | 31 | 94 | 36 | 192 | 190 |
| | | Run 12 | 0.2 | 1.8 | 11 | 33 | 2.7 | 411 | 2 | 32 | 93 | 37 | 194 | 180 |
| | | Run 13 | 0.2 | 2.0 | 12 | 31 | 2.7 | 410 | 2 | 31 | 95 | 37 | 190 | 180 |
| | | Run 14 | 0.2 | 1.9 | 10 | 32 | 2.7 | 420 | 2 | 30 | 93 | 36 | 190 | 190 |
| | | RSD (%) | **18.5** | **6.0** | **9** | **3** | **3.1** | **2** | **12** | **4** | **2** | **5** | **1** | **5** |
| | TILL 3 | Run 1 | 1.6 | 0.2 | 10 | 21 | 2.0 | 210 | 2 | 27 | 17 | 40 | 39 | 110 |
| | | Run 2 | 1.6 | 0.2 | 12 | 21 | 1.7 | 221 | 2 | 28 | 16 | 46 | 37 | 100 |
| | | Run 3 | 1.5 | 0.2 | 11 | 20 | 1.6 | 206 | <1 | 26 | 16 | 45 | 35 | 80 |
| | | Run 4 | 1.4 | <0.2 | 11 | 23 | 1.8 | 250 | <1 | 30 | 18 | 38 | 37 | 120 |
| | | Run 5 | 1.4 | <0.2 | 10 | 22 | 1.8 | 255 | <1 | 29 | 17 | 45 | 35 | 120 |
| | | Run 6 | 1.4 | <0.2 | 11 | 22 | 1.9 | 250 | 1 | 29 | 18 | 46 | 34 | 120 |
| | | Run 7 | 1.6 | <0.2 | 11 | 22 | 1.6 | 235 | 1 | 30 | 17 | 33 | 59 | 110 |
| | | Run 8 | 1.7 | <0.2 | 12 | 24 | 1.8 | 235 | 2 | 29 | 18 | 36 | 50 | 100 |
| | | Run 9 | 1.7 | 0.2 | 11 | 22 | 1.8 | 235 | 1 | 29 | 16 | 37 | 41 | 100 |
| | | RSD (%) | **7.5** | **34.4** | **6** | **5** | **6.9** | **7** | **53.5** | **4** | **5** | **11** | **19** | **12** |
| | TILL 2 | Run 1 | 0.2 | 0.3 | 13 | 149 | 2.8 | 410 | 12 | 26 | 20 | 52 | 110 | 80 |
| | | Run 2 | 0.4 | 0.4 | 12 | 154 | 2.8 | 407 | 14 | 27 | 21 | 50 | 112 | 90 |
| | | Run 3 | 0.2 | 0.3 | 13 | 143 | 3.0 | 384 | 13 | 25 | 21 | 50 | 106 | 90 |
| | | RSD (%) | **35.4** | **14.1** | **4** | **3** | **3.3** | **3** | **6** | **3** | **2** | **2** | **2** | **5** |
| | TILL 1 | Run 1 | 0.2 | 0.3 | 11 | 48 | 3.0 | 860 | 2 | 17 | 12 | 50 | 60 | 90 |
| | | Run 2 | 0.2 | <0.2 | 11 | 48 | 2.8 | 840 | 1 | 18 | 14 | 50 | 62 | 100 |
| | | Run 3 | 0.2 | 0.3 | 15 | 49 | 2.6 | 810 | 1 | 15 | 14 | 53 | 64 | 100 |
| | | Run 4 | 0.3 | 0.2 | 14 | 48 | 2.7 | 820 | 1 | 15 | 14 | 54 | 61 | 100 |
| | | Run 5 | 0.2 | 0.2 | 11 | 46 | 2.6 | 820 | 2 | 14 | 14 | 54 | 58 | 100 |
| | | RSD (%) | **18.2** | **34.0** | **14** | **2** | **5.5** | **2** | **35** | **9** | **6** | **4** | **3** | **4** |

APPENDIX V: Table II - Accepted Values for Geochemical Standards - AAS

| AAS Accepted Values | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Element | | | Ag | Cd | Co | Cu | Fe | Mn | Mo | Ni | Pb | V | Zn | Hg |
| Units | | | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppb |
| STANDARDS | LKSD-4 | | 0.2 | 1.9 | 11 | 30 | 2.8 | 430 | 2 | 31 | 95 | 34 | 194 | |
| | | average | 0.2 | 1.9 | 9 | 32 | 2.8 | 420 | 2 | 30 | 93 | 32 | 194 | 179 |
| | | st.dev | 0.0 | 0.0 | 1 | 0 | 0.0 | 0 | 0 | 0 | 3 | 2 | 1 | 9 |
| | | max | 0.2 | 1.9 | 9 | 32 | 2.8 | 420 | 2 | 30 | 95 | 34 | 195 | 190 |
| | | min | 0.2 | 1.9 | 8 | 32 | 2.8 | 420 | 2 | 30 | 90 | 30 | 193 | 160 |
| | *TILL3 | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | average | 1.5 | 0.1 | 11 | 22 | 1.8 | 233 | 1 | 29 | 17 | 41 | 41 | 107 |
| | | st.dev | 0.1 | 0.1 | 1 | 1 | 0.1 | 17 | 1 | 1 | 1 | 5 | 8 | 12 |
| | | max | 1.7 | 0.2 | 12 | 24 | 2.0 | 255 | 2 | 30 | 18 | 46 | 59 | 120 |
| | | min | 1.4 | 0.0 | 10 | 20 | 1.6 | 206 | 0 | 26 | 16 | 33 | 34 | 80 |
| | TILL2 | | 0.2 | 0.3 | 15 | 150 | 3.8 | 410 | 32 | 26 | 95 | 34 | 193 | 74 |
| | | average | 0.3 | 0.3 | 13 | 149 | 2.9 | 400 | 13 | 26 | 21 | 51 | 109 | 87 |
| | | st.dev | 0.1 | 0.0 | 0 | 4 | 0.1 | 12 | 1 | 1 | 0 | 1 | 2 | 5 |
| | | max | 0.4 | 0.4 | 13 | 154 | 3.0 | 410 | 14 | 27 | 21 | 52 | 112 | 90 |
| | | min | 0.2 | 0.3 | 12 | 143 | 2.8 | 384 | 12 | 25 | 20 | 50 | 106 | 80 |
| | TILL1 | | 0.2 | <0.2 | 11 | 47 | 2.8 | 840 | 2 | 18 | 14 | 50 | 62 | 92 |
| | | average | 0.2 | 0.2 | 11 | 48 | 2.9 | 850 | 2 | 18 | 13 | 50 | 61 | 61 |
| | | st.dev | 0.0 | 0.1 | 0 | 0 | 0.1 | 10 | 1 | 1 | 1 | 0 | 1 | 1 |
| | | max | 0.2 | 0.3 | 11 | 48 | 3.0 | 860 | 2 | 18 | 14 | 50 | 62 | 62 |
| | | min | 0.2 | 0.1 | 11 | 48 | 2.8 | 840 | 1 | 17 | 12 | 50 | 60 | 60 |

*NOTE: This study was the first run for this standard, therefore an accepted value has yet to be established

APPENDIX V: Table III: Analytical Values for Geochemical Standards - INAA

| INAA Experimental Values | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Element | | | As | Ba | Br | Ce | Cr | Cs | La | Na | Sb | Sc | Sm | Tb | Th | U | Yb |
| Units | | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| STANDARDS | LSKD-4 | Run 1 | 15 | 360 | 50.0 | 52 | 27 | 0.8 | 27 | 0.61 | 1.8 | 7.7 | 5.2 | 0.8 | 4.7 | 30.3 | 2 |
| | | Run 2 | 16 | 270 | 47.0 | 52 | 28 | 1.7 | 26 | 0.60 | 1.7 | 7.8 | 5.2 | 0.6 | 5.1 | 29.4 | 2 |
| | | Run 3 | 16 | 290 | 50.8 | 53 | 39 | 1.3 | 27 | 0.65 | 1.8 | 7.8 | 4.0 | 0.9 | 5.3 | 31.7 | 2 |
| | | Run 4 | 16 | 300 | 53.1 | 48 | 33 | 1.5 | 26 | 0.61 | 1.8 | 7.5 | 4.3 | 1.0 | 5.2 | 32.0 | 2 |
| | | Run 5 | 17 | 280 | 55.0 | 55 | 48 | 1.8 | 26 | 0.63 | 1.9 | 7.4 | 4.4 | 0.9 | 5.2 | 33.4 | 2 |
| | | Run 6 | 16 | 320 | 50.0 | 55 | 54 | -0.5 | 29 | 0.65 | 1.8 | 8.6 | 5.1 | 1.0 | 5.7 | 31.7 | -2 |
| | | Run 7 | 16 | 300 | 50.0 | 58 | 44 | 1.6 | 28 | 0.64 | 1.7 | 8.3 | 4.9 | -0.5 | 4.8 | 30.6 | 3 |
| | | Run 8 | 16 | 320 | 51.4 | 50 | -20 | 2.1 | 26 | 0.59 | 1.9 | 7.9 | 5.4 | -0.5 | 5.6 | 32.4 | 2 |
| | | Run 9 | 17 | 380 | 50.0 | 55 | 37 | 1.4 | 27 | 0.61 | 1.8 | 8.2 | 4.9 | 0.6 | 5.4 | 32.3 | 3 |
| | | Run 10 | 17 | 350 | 53.7 | 60 | 34 | 1.9 | 29 | 0.64 | 1.8 | 8.1 | 5.5 | 0.8 | 5.2 | 33.2 | 3 |
| | | Run 11 | 16 | 330 | 50.5 | 55 | 33 | 1.4 | 28 | 0.62 | 1.9 | 8.0 | 5.5 | -0.5 | 4.9 | 32.8 | 3 |
| | | Run 12 | 17 | 310 | 54.4 | 56 | 43 | 1.8 | 28 | 0.58 | 2.0 | 7.7 | 5.4 | 0.6 | 5.5 | 33.7 | 3 |
| | | Run 13 | 15 | 360 | 51.1 | 51 | 30 | 1.5 | 27 | 0.59 | 1.8 | 8.1 | 5.2 | 0.7 | 5.3 | 33.3 | 3 |
| | | Run 14 | 17 | 350 | 52.0 | 45 | 34 | 1.5 | 26 | 0.56 | 1.9 | 7.5 | 5.0 | 0.7 | 5.0 | 32.7 | 3 |
| | | RSD (%) | 4 | 10 | 4.0 | 7 | 29 | 30.7 | 4 | 4.29 | 4.3 | 4.1 | 9.0 | 38.0 | 5.4 | 3.8 | 26 |
| | TILL 3 | Run 1 | 90.7 | 490 | 5.0 | 39 | 16 | 2.0 | 20 | 2.02 | 0.9 | 11.0 | 3.3 | -0.5 | 4.7 | 2.0 | 1 |
| | | Run 2 | 91.7 | 490 | 5.3 | 42 | 15 | 2.0 | 20 | 2.15 | 0.9 | 11.0 | 3.4 | -0.5 | 4.6 | 1.9 | 2 |
| | | Run 3 | 89.6 | 490 | 4.9 | 44 | 16 | 2.0 | 20 | 2.28 | 0.9 | 11.0 | 3.4 | -0.5 | 5.0 | 1.9 | 2 |
| | | Run 4 | 89.9 | 430 | 4.7 | 43 | 17 | 2.0 | 20 | 2.00 | 0.9 | 10.0 | 3.4 | -0.5 | 4.5 | 2.0 | 2 |
| | | Run 5 | 85.8 | 500 | 4.3 | 39 | 13 | 1.9 | 20 | 2.02 | 0.8 | 10.0 | 3.3 | 0.5 | 4.7 | 1.9 | 2 |
| | | Run 6 | 86.3 | 470 | 4.7 | 46 | 15 | 1.9 | 20 | 1.80 | 0.8 | 9.1 | 3.2 | -0.5 | 4.6 | 1.9 | 2 |
| | | RSD (%) | 2.5 | 5 | 6.4 | 6 | 8 | 2.4 | 0 | 7.19 | 5.4 | 6.9 | 2.2 | 31.9 | 3.4 | 2.4 | 20 |
| | TILL 2 | Run 1 | 27.0 | 550 | 12.0 | 120 | 79 | 12.0 | 45 | 1.70 | 0.9 | 13.0 | 7.3 | 0.9 | 18.0 | 5.4 | 3 |
| | | Run 2 | 27.0 | 530 | 13.0 | 120 | 72 | 12.0 | 46 | 1.80 | 0.8 | 14.0 | 7.4 | 1.1 | 18.0 | 5.4 | 3 |
| | | Run 3 | 27.0 | 530 | 13.0 | 120 | 84 | 12.0 | 46 | 1.90 | 0.9 | 14.0 | 7.4 | 1.5 | 19.0 | 5.5 | 3 |
| | | RSD (%) | 0 | 2 | 4 | 0 | 6 | 0 | 1 | 4.5 | 5.4 | 3 | 0.6 | 21.4 | 3 | 0.9 | 0 |
| | TILL 1 | Run 1 | 19.0 | 720 | 6.8 | 63 | 1.1 | 76 | 28 | 2.04 | 8.3 | 13.0 | 6.3 | 0.9 | 5.4 | 2.3 | 4 |
| | | Run 2 | 19.0 | 730 | 6.4 | 70 | 0.8 | 69.0 | 27 | -0.5 | 8.1 | 14.( | 6.2 | 1.0 | 5.3 | -1 | 3 |
| | | Run 3 | 18.0 | 640 | 7.1 | 82 | 0.9 | 54 | 31 | 2.30 | 8.1 | 16.0 | 6.7 | 0.7 | 5.8 | 2.2 | 4 |
| | | Run 4 | 19.0 | 740 | 6.1 | 76 | 1.4 | 72 | 33 | 2.32 | 8.1 | 16.0 | 6.9 | 0.5 | 5.6 | 2.2 | 4 |
| | | Run 5 | 18.0 | 730 | 6.8 | 66 | 0.9 | 50 | 27 | 1.90 | 8.1 | 13.0 | 6.5 | 1.3 | 5.3 | 2.2 | 4 |
| | | RSD (%) | 3 | 5 | 5.3 | 10 | 20.9 | 16 | 8 | 66.2 | 1.0 | 9 | 3.9 | 30.8 | 3.5 | 36.8 | 11 |

APPENDIX V: Table IV: Accepted Values for Geochemical Standards - INAA

| INAA Accepted Values | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Element | | | As | Ba | Br | Ce | Cr | Cs | La | Na | Sb | Sc | Sm | Tb | Th | U | Yb |
| Units | | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| STANDARDS | LKSD-4 | | 16.0 | 330 | N/A | N/A | 33 | 1.7 | 26 | N/A | 1.7 | 7.0 | N/A | N/A | 5.1 | 31.0 | 2 |
| | | average | 15.9 | 371 | 51.0 | 52 | 36 | 1.2 | 28 | 0.57 | 1.8 | 7.0 | 4.4 | 0.6 | 5.2 | 33.3 | 2 |
| | | st. dev. | 2.3 | 99 | 7.0 | 8 | 6 | 0.7 | 4 | 0.08 | 0.3 | 0.9 | 0.7 | 0.4 | 0.3 | 5.6 | 0 |
| | | max | 20.0 | 550 | 67.3 | 65 | 50 | 3.0 | 35 | 0.73 | 2.3 | 8.8 | 6.0 | 2.2 | 5.7 | 46.0 | 3 |
| | | min | 5.5 | 160 | 18.0 | 21 | 11 | 0.5 | 10 | 0.20 | 0.5 | 2.7 | 1.8 | 0.3 | 4.7 | 12.0 | 1 |
| | *TILL3 | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | average | 89.0 | 478 | 4.8 | 42 | 15 | 2.0 | 20 | 2.0 | 0.9 | 10.4 | 3.3 | -0.3 | 4.7 | 1.9 | 2 |
| | | st. dev. | 2.2 | 23 | 0.3 | 3 | 1 | 0.0 | 0 | 0.1 | 0.0 | 0.7 | 0.1 | 0.4 | 0.2 | 0.0 | 0 |
| | | max | 91.7 | 500 | 5.3 | 46 | 17 | 2.0 | 20 | 2.3 | 0.9 | 11.0 | 3.4 | 0.5 | 5.0 | 2.0 | 2 |
| | | min | 85.8 | 430 | 4.3 | 39 | 13 | 1.9 | 20 | 1.8 | 0.8 | 9.1 | 3.2 | -0.5 | 4.5 | 1.9 | 1 |
| | TILL2 | | 26.0 | 540 | 12.2 | 98 | 74 | 12.0 | 44 | 1.62 | 0.8 | 12.0 | 7.4 | 1.2 | 18.4 | 5.7 | 4 |
| | | average | 28.2 | 565 | 15.9 | 110 | 75 | 14.0 | 50 | 1.79 | 1.0 | 13.5 | 8.3 | 0.7 | 18.3 | 5.4 | 4 |
| | | st. dev. | 3.3 | 125 | 2.7 | 32 | 6 | 3.0 | 7 | 0.23 | 0.1 | 1.8 | 1.0 | 0.4 | 0.5 | 0.4 | 1 |
| | | max | 31.4 | 690 | 18.6 | 142 | 80 | 17.0 | 57 | 2.01 | 1.0 | 15.3 | 9.3 | 1.1 | 19.0 | 5.7 | 5 |
| | | min | 24.9 | 440 | 13.2 | 78 | 69 | 11.0 | 43 | 1.56 | 0.9 | 11.7 | 7.3 | 0.3 | 18.0 | 5.0 | 3 |
| | TILL1 | | 18.0 | 702 | 6.4 | 71 | 65 | 1.0 | 28 | 2.01 | 7.8 | 13.0 | 5.9 | 1.1 | 5.1 | 2.2 | 4 |
| | | average | 19.7 | 738 | 7.0 | 71 | 69 | 1.3 | 28 | 2.07 | 7.8 | 14.1 | 6.2 | 0.7 | 8.2 | 2.3 | 4 |
| | | st. dev. | 1.6 | 13 | 0.4 | 11 | 5 | 0.6 | 1 | 0.04 | 0.4 | 1.5 | 0.6 | 0.3 | 5.4 | 0.6 | 1 |
| | | max | 22.5 | 750 | 7.6 | 89 | 76 | 2.0 | 30 | 2.13 | 8.3 | 16.6 | 7.0 | 1.0 | 19.0 | 3.3 | 5 |
| | | min | 18.4 | 720 | 6.4 | 60 | 62 | 0.5 | 27 | 2.04 | 7.2 | 12.7 | 5.3 | 0.3 | 5.3 | 1.5 | 3 |

*Note: This study was the first run for this standard, therefore an accepted values has yet to be established

APPENDIX V: Table V - Geochemistry of Field Duplicates for Selected Elements - AAS

| Atomic Absorption Spectrometry (AAS) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Element** | **Ag** | **Cd** | **Co** | **Cu** | **Fe** | **Hg** | **Mn** | **Mo** | **Ni** | **Pb** | **V** | **Zn** |
| **Units** | **ppm** | **ppm** | **ppm** | **ppm** | **%** | **ppb** | **ppm** | **ppm** | **ppm** | **ppm** | **ppm** | **ppm** |
| **ML980002** | <0.2 | 0.3 | 8 | 53 | 2.6 | 100 | 194 | 1 | 67 | 49 | 51 | 220 |
| **ML980111-FD** | 0.4 | 0.5 | 10 | 50 | 2.8 | 100 | 174 | 2 | 68 | 47 | 42 | 189 |
| **RSD (%)** | **84.9** | **35.4** | **16** | **4** | **5.2** | **0** | **8** | **47** | **1** | **3** | **14** | **11** |
| **ML980022** | 0.9 | 0.4 | 8 | 23 | 2.3 | 80 | 110 | 1 | 48 | 20 | 36 | 96 |
| **ML980022A** | 1.0 | 0.4 | 9 | 22 | 2.2 | 70 | 116 | 1 | 49 | 19 | 34 | 100 |
| **RSD (%)** | **7.4** | **0.0** | **8** | **3** | **3.1** | **9** | **4** | **0** | **1** | **4** | **4** | **3** |
| **ML980027** | 0.4 | <0.2 | 9 | 20 | 2.3 | 50 | 130 | 1 | 45 | 24 | 49 | 72 |
| **ML980112-FD** | 0.2 | 0.3 | 9 | 20 | 2.5 | 60 | 116 | 1 | 50 | 24 | 45 | 76 |
| **RSD (%)** | **47.1** | **70.7** | **0** | **0** | **5.9** | **13** | **8** | **0** | **7** | **0** | **6** | **4** |
| **ML980056** | 0.2 | <0.2 | 12 | 67 | 2.2 | 50 | 113 | 3 | 52 | 18 | 54 | 49 |
| **ML980056A** | 0.3 | <0.2 | 10 | 53 | 2.5 | 70 | 90 | 1 | 55 | 14 | 58 | 60 |
| **RSD (%)** | **28.3** | **0.0** | **13** | **16** | **9.0** | **24** | **16** | **71** | **4** | **18** | **5** | **14** |
| **ML980057** | <0.2 | 0.2 | 11 | 21 | 2.3 | 60 | 104 | 2 | 52 | 14 | 32 | 54 |
| **ML980113-FD** | 0.2 | 0.2 | 11 | 25 | 2.5 | 70 | 128 | <1 | 64 | 16 | 36 | 58 |
| **RSD (%)** | **47.1** | **0.0** | **0** | **12** | **5.9** | **11** | **15** | **85** | **15** | **9** | **8** | **5** |
| **ML980071** | 0.2 | 0.3 | 12 | 194 | 2.1 | 70 | 150 | 4 | 30 | 7 | 49 | 37 |
| **ML980114-FD** | 0.2 | 0.2 | 12 | 221 | 2.3 | 60 | 166 | 4 | 36 | 6 | 53 | 36 |
| **RSD (%)** | **0.0** | **28.3** | **0** | **9** | **6.4** | **11** | **7** | **0** | **13** | **11** | **6** | **2** |
| **ML980073** | <0.2 | 0.4 | 12 | 395 | 2.8 | 60 | 124 | 22 | 46 | 21 | 70 | 49 |
| **ML980073A** | <0.2 | 0.2 | 12 | 362 | 2.7 | 70 | 126 | 19 | 47 | 19 | 65 | 48 |
| **RSD (%)** | **0.0** | **47.1** | **0** | **6** | **2.6** | **11** | **1** | **10** | **2** | **7** | **5** | **1** |
| **MP990036** | 0.3 | 0.2 | 14 | 12 | 3.0 | 46 | 20 | 170 | 1 | 40 | 10 | 47 |
| **MP990015-FD** | 0.2 | 0.2 | 15 | 11 | 2.9 | 45 | 30 | 170 | 1 | 39 | 11 | 43 |
| **RSD (%)** | **28.3** | **0.0** | **5** | **6** | **2.4** | **2** | **28** | **0** | **0** | **2** | **-7** | **6** |
| **MP990030** | 0.2 | 0.3 | 6 | 12 | 1.6 | 80 | 60 | 64 | <1 | 22 | 14 | 30 |
| **MP990032-FD** | <0.2 | 0.2 | 8 | 13 | 1.8 | 85 | 30 | 71 | 2 | 23 | 15 | 33 |
| **RSD (%)** | **47.1** | **28.3** | **20** | **6** | **8.3** | **4** | **47** | **7** | **85** | **3** | **5** | **7** |
| **MP990041** | 0.3 | <0.2 | 9 | 11 | 2.2 | 42 | 30 | 138 | <1 | 26 | 9 | 35 |
| **MP990051-FD** | <0.2 | <0.2 | 7 | 11 | 2.1 | 44 | 40 | 135 | <1 | 26 | 9 | 35 |
| **RSD (%)** | **70.7** | **0.0** | **18** | **0** | **3.3** | **3** | **20** | **2** | **0** | **0** | **0** | **0** |
| **MP990068** | <0.2 | <0.2 | 8 | 19 | 2.5 | 37 | 80 | 124 | 1 | 25 | 8 | 29 |
| **MP990069-FD** | 0.2 | 0.2 | 8 | 20 | 2.3 | 38 | 60 | 133 | 2 | 24 | 9 | 28 |
| **RSD (%)** | **47.1** | **47.1** | **0** | **4** | **5.9** | **2** | **20** | **5** | **47** | **3** | **8** | **2** |

*NOTE: Samples labelled as 'A' or 'FD' denote the field duplicates

APPENDIX V: Table VI - Geochemistry of Field Duplicates for Selected Elements - INAA

| Instrumental Neutron Activation Analysis (INAA) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Element | As | Ba | Ce | Cr | Cs | Hf | La | Rb | Sb | Sc | Sm | Th | U | W | Yb | Zr |
| Units | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| ML980002 | 26 | 470 | 71 | 250 | 3.1 | 7 | 26 | 71 | 1.4 | 10 | 3.5 | 8.5 | 2.5 | 1 | 1 | -200 |
| ML980111-FD | 25 | 450 | 75 | 280 | 3.1 | 8 | 28 | 76 | 1.3 | 12 | 3.6 | 9.0 | 2.5 | 1 | 2 | -200 |
| RSD (%) | 3 | 3 | 4 | 8 | 0.0 | 9 | 5 | 5 | 5.2 | 13 | 2.0 | 4.0 | 0.0 | 0 | 47 | 0 |
| ML980022 | 14 | 360 | 56 | 260 | 2.6 | 11 | 29 | 64 | 0.9 | 10 | 4.1 | 8.1 | 2.7 | -1 | 2 | 310 |
| ML980022A | 14 | 360 | 61 | 230 | 2.5 | 10 | 29 | 69 | 0.9 | 10 | 4.1 | 8.0 | 2.6 | 1 | 2 | 320 |
| RSD (%) | 0 | 0 | 6 | 9 | 2.8 | 7 | 0 | 5 | 0.0 | 0 | 0.0 | 0.9 | 2.7 | 47 | 0 | 2 |
| ML980027 | 21 | 400 | 76 | 260 | 3.0 | 13 | 34 | 75 | 0.9 | 12 | 4.9 | 9.0 | 2.9 | 1 | 3 | 390 |
| ML980112-FD | 20 | 400 | 70 | 240 | 3.1 | 11 | 32 | 72 | 0.8 | 12 | 4.6 | 8.2 | 2.6 | 1 | 2 | 320 |
| RSD (%) | 3 | 0 | 6 | 6 | 2.0 | 12 | 4 | 3 | 8.3 | 0 | 4.5 | 6.6 | 7.7 | 0 | 28 | 14 |
| ML980056 | 19 | 490 | 80 | 190 | 3.5 | 11 | 36 | 75 | 0.8 | 13 | 4.7 | 9.2 | 2.7 | 3 | 2 | 510 |
| ML980056A | 18 | 400 | 65 | 150 | 4.1 | 8 | 27 | 68 | 0.6 | 12 | 4.0 | 8.1 | 2.6 | 1 | 2 | 310 |
| RSD (%) | 4 | 14 | 15 | 17 | 11.0 | 22 | 20 | 7 | 20.2 | 6 | 11.4 | 9.0 | 2.7 | 71 | 0 | 34 |
| ML980057 | 16 | 360 | 70 | 180 | 3.3 | 9 | 29 | 73 | 1.0 | 10 | 4.6 | 8.9 | 2.6 | 1 | 2 | 360 |
| ML980113-FD | 19 | 370 | 86 | 200 | 3.1 | 10 | 35 | 81 | 1.0 | 13 | 5.2 | 10.0 | 2.7 | 1 | 2 | 330 |
| RSD (%) | 12 | 2 | 15 | 7 | 4.4 | 7 | 13 | 7 | 0.0 | 18 | 8.7 | 8.2 | 2.7 | 0 | 0 | 6 |
| ML980071 | 3.9 | 480 | 83 | 130 | 2.6 | 13 | 37 | 88 | 0.3 | 14 | 4.7 | 14.0 | 3.3 | 2 | 2 | 350 |
| ML980114-FD | 3.9 | 520 | 89 | 120 | 3.0 | 13 | 36 | 93 | 0.4 | 14 | 4.8 | 14.0 | 3.4 | 3 | 2 | 400 |
| RSD (%) | 0 | 6 | 5 | 6 | 10.1 | 0 | 2 | 4 | 20.2 | 0 | 1.5 | 0.0 | 2.1 | 28 | 0 | 9 |
| ML980073 | 17 | 490 | 78 | 170 | 3.8 | 9 | 36 | 86 | 0.6 | 15 | 4.7 | 11.0 | 3.1 | 8 | 2 | -200 |
| ML980073A | 16 | 480 | 76 | 180 | 3.7 | 9 | 36 | 82 | 0.6 | 15 | 4.9 | 11.0 | 3.1 | 6 | 2 | 280 |
| RSD (%) | 4 | 1 | 2 | -4 | 1.9 | 0 | 0 | 3 | 0.0 | 0 | -2.9 | 0.0 | 0.0 | 20 | 0 | 67 |
| MP990036 | 5.2 | 360 | 87 | 150 | 2.7 | 9 | 32 | 70 | 0.5 | 12 | 4.5 | 7.7 | 2.4 | 1 | 4 | -200 |
| MP990015-FD | 4.8 | 380 | 85 | 140 | 2.5 | 8 | 31 | 71 | 0.5 | 12 | 4.5 | 7.4 | 2.5 | -1 | 4 | 450 |
| RSD (%) | 6 | 4 | 2 | 5 | 5.4 | 8 | 2 | 1 | 0.0 | 0 | 0.0 | 2.8 | 2.9 | 47 | 0 | 90 |
| MP990030 | 4.5 | 300 | 87 | 130 | 2.2 | 11 | 35 | 66 | 0.7 | 8.6 | 4.6 | 11.0 | 2.5 | 1 | 4 | 560 |
| MP990032-FD | 4.6 | 300 | 89 | 130 | 2.1 | 10 | 34 | 77 | 0.7 | 8.8 | 4.6 | 11.0 | 2.4 | -1 | 3 | 580 |
| RSD (%) | 2 | 0 | 2 | 0 | 3.3 | 7 | 2 | 11 | 0.0 | 2 | 0.0 | 0.0 | 2.9 | 47 | 20 | 2 |
| MP990041 | 4.7 | 290 | 83 | 140 | 2.3 | 13 | 34 | 63 | 0.6 | 8.9 | 4.8 | 8.9 | 2.8 | -1 | 5 | 570 |
| MP990051-FD | 4.7 | 280 | 76 | 140 | 2.1 | 13 | 32 | 59 | 0.5 | 8.8 | 4.6 | 8.6 | 2.5 | 1 | 4 | 540 |
| RSD (%) | 0 | 2 | 6 | 0 | 6.4 | 0 | 4 | 5 | 12.9 | 1 | 3.0 | 2.4 | 8.0 | 47 | 16 | 4 |
| MP990068 | 5.0 | 270 | 89 | 110 | 3.2 | 11 | 35 | 53 | 0.6 | 11 | 4.9 | 6.8 | 2.4 | -1 | 3 | 390 |
| MP990069-FD | 5.2 | 270 | 100 | 130 | 3.4 | 12 | 36 | 64 | 0.8 | 11 | 4.9 | 7.8 | 2.4 | -1 | 4 | -200 |
| RSD (%) | 3 | 0 | 8 | 12 | 4.3 | 6 | 2 | 13 | 20.2 | 0 | 0.0 | 9.7 | 0.0 | 0 | 20 | 84 |

*NOTE: Samples labelled as 'A' or 'FD' denote the field duplicates

APPENDIX V: Table VII - Geochemistry of Lab Duplicates for Selected Elements -AAS

| Atomic Absorption Spectrometry (AAS) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Element | Ag | Cd | Co | Cu | Fe | Hg | Mn | Mo | Ni | Pb | V | Zn |
| Units | ppm | ppm | ppm | ppm | % | ppb | ppm | ppm | ppm | ppm | ppm | ppm |
| S12 | 0.2 | 0.2 | 10 | 21 | 1.9 | 87 | 1 | 35 | 8 | 40 | 38 | 60 |
| T15 | <0.2 | <0.2 | 9 | 19 | 1.9 | 93 | <1 | 34 | 8 | 41 | 38 | 60 |
| RSD (%) | 47.1 | 47.1 | 7 | 7 | 0.0 | 5 | 47.1 | 2 | 0.0 | 2 | 0 | 0 |
| Q11 | 0.2 | <0.2 | 14 | 19 | 3.0 | 145 | <1 | 62 | 7 | 31 | 59 | 30 |
| 85LFA0519 | <0.2 | <0.2 | 14 | 18 | 2.8 | 160 | 1 | 65 | 7 | 33 | 60 | 30 |
| RSD (%) | 47.1 | 0.0 | 0 | 4 | 4.9 | 7 | 47.1 | 3 | 0 | 4 | 1 | 0 |
| T10 | 0.2 | <0.2 | 11 | 17 | 2.5 | 126 | <1 | 46 | 9 | 39 | 54 | 60 |
| 87LFA2039 | 0.2 | <0.2 | 12 | 18 | 2.6 | 136 | <1 | 52 | 10 | 35 | 60 | 60 |
| RSD (%) | 0.0 | 0.0 | 6 | 4 | 2.8 | 5 | 0.0 | 9 | 7 | 8 | 7 | 0 |
| R14 | 0.2 | <0.2 | 12 | 31 | 2.5 | 112 | 1 | 49 | 11 | 50 | 55 | 80 |
| 87LFA2016A | <0.2 | 0.2 | 13 | 30 | 2.4 | 118 | 1 | 51 | 12 | 52 | 54 | 90 |
| RSD (%) | 47.1 | 47.1 | 6 | 2 | 2.9 | 4 | 0.0 | 3 | 6 | 3 | 1 | 8 |
| 86LFA5400 | <0.2 | <0.2 | 15 | 21 | 2.8 | 293 | <1 | 58 | 22 | 46 | 61 | 60 |
| 87LFA2242A | <0.2 | <0.2 | 17 | 18 | 2.1 | 338 | 1 | 48 | 15 | 49 | 58 | 30 |
| RSD (%) | 0.0 | 0.0 | 9 | 11 | 20.2 | 10 | 47.1 | 13 | 27 | 4 | 4 | 47 |
| 86LFA5418 | 0.2 | 0.2 | 10 | 13 | 2.4 | 202 | 1 | 26 | 7 | 40 | 40 | 60 |
| 86LFA5434 | <0.2 | 0.2 | 10 | 13 | 2.3 | 207 | 2 | 27 | 9 | 40 | 52 | 60 |
| RSD (%) | 47.1 | 0.0 | 0 | 0 | 3.0 | 2 | 47 | 3 | 18 | 0 | 18 | 0 |
| ML980039 | 0.6 | 0.2 | 13 | 104 | 2.7 | 164 | 1 | 101 | 27 | 42 | 76 | 40 |
| ML980030A | 0.6 | <0.2 | 12 | 103 | 2.8 | 169 | 4 | 103 | 29 | 44 | 76 | 40 |
| RSD (%) | 0.0 | 47.1 | 6 | 1 | 2.6 | 2 | 85 | 1 | 5 | 3 | 0 | 0 |
| ML980065 | <0.2 | <0.2 | 11 | 96 | 2.4 | 120 | 5 | 52 | 12 | 50 | 46 | 60 |
| ML980060A | <0.2 | <0.2 | 11 | 95 | 2.6 | 120 | 5 | 52 | 12 | 56 | 46 | 50 |
| RSD (%) | 0.0 | 0.0 | 0 | 1 | 5.7 | 0 | 0 | 0 | 0 | 8 | 0 | 13 |
| ML980105 | <0.2 | 0.3 | 10 | 47 | 2.4 | 119 | 1 | 55 | 11 | 49 | 43 | 80 |
| ML980100A | 0.2 | <0.2 | 10 | 48 | 2.5 | 120 | 2 | 56 | 12 | 47 | 48 | 80 |
| RSD (%) | 47.1 | 70.7 | 0 | 1 | 2.9 | 1 | 47 | 1 | 6 | 3 | 8 | 0 |
| MP990006 | <0.2 | <0.2 | 7 | 12 | 1.8 | 40 | 63 | <1 | 31 | 6 | 26 | 41 |
| MP990057 | <0.2 | 0.2 | 7 | 12 | 1.7 | 50 | 69 | <1 | 29 | 7 | 24 | 38 |
| RSD (%) | 0.0 | 47.1 | 0 | 0 | 4.0 | 16 | 6 | 0.0 | 5 | 11 | 6 | 5 |
| MP990042 | <0.2 | 0.3 | 7 | 13 | 2.3 | 100 | 115 | 1 | 23 | 11 | 32 | 139 |
| MP990059 | 0.2 | 0.2 | 7 | 14 | 2.4 | 90 | 122 | 1 | 24 | 11 | 30 | 150 |
| RSD (%) | 47.1 | 28.3 | 0 | 5 | 3.0 | 7 | 4 | 0 | 3 | 0 | 5 | 5 |
| MP990054 | <0.2 | 0.2 | 9 | 15 | 2.4 | 80 | 114 | <1 | 32 | 8 | 45 | 44 |
| MP990071 | <0.2 | 0.3 | 10 | 16 | 2.6 | 90 | 125 | <1 | 33 | 9 | 45 | 47 |
| RSD (%) | 0.0 | 28.3 | 7 | 5 | 5.7 | 8 | 7 | 0.0 | 2 | 8 | 0 | 5 |
| MP990024 | <0.2 | <0.2 | 11 | 21 | 2.9 | 60 | 299 | 1 | 37 | 14 | 47 | 50 |
| MP990072 | 0.2 | 0.2 | 13 | 23 | 3.1 | 60 | 331 | <1 | 37 | 15 | 52 | 53 |
| RSD (%) | 47.1 | 47.1 | 12 | 6 | 4.7 | 0 | 7 | 47 | 0 | 5 | 7 | 4 |

APPENDIX V: APPENDIX V: Table VIII - Geochemistry of Lab Duplicates for Selected Elements - INAA

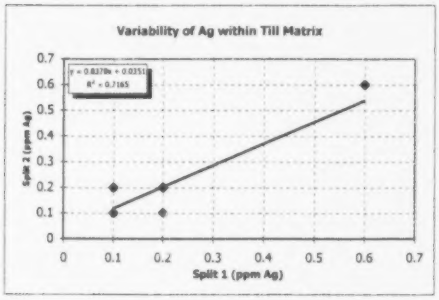
| Instrumental Neutron Activation Analysis (INAA) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Element | As | Au | Ba | Br | Ce | Cr | Cs | Hf | La | Rb |
| Units | ppm | ppb | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| S12 | 5.8 | -2 | 470 | 11 | 74 | 200 | 2.8 | 12 | 31 | 81 |
| T15 | 5.7 | -2 | 490 | 11 | 72 | 180 | 3.2 | 11 | 29 | 71 |
| RSD (%) | 1.2 | 0 | 3 | 0 | 2 | 7 | 9.4 | 6 | 5 | 9 |
| Q11 | 5.7 | -2 | 330 | 4.7 | 66 | 170 | 3.5 | 6 | 30 | 95 |
| 85LFA0519 | 5.2 | -2 | 340 | 4.6 | 69 | 180 | 3.6 | 7 | 30 | 96 |
| RSD (%) | 6.5 | 0 | 2 | 1.5 | 3 | 4 | 2.0 | 11 | 0 | 1 |
| T10 | 4.9 | 5 | 460 | 7.5 | 73 | 210 | 6.0 | 11 | 29 | 84 |
| 87LFA2039 | 4.9 | 2 | 460 | 8.5 | 66 | 190 | 5.9 | 10 | 29 | 95 |
| RSD (%) | 0.0 | 61 | 0 | 8.8 | 7 | 7 | 1.2 | 7 | 0 | 9 |
| R14 | 9.5 | -2 | 390 | 10 | 71 | 150 | 4.4 | 12 | 28 | 74 |
| 87LFA2016A | 9.4 | -2 | 410 | 10 | 76 | 160 | 3.9 | 11 | 28 | 72 |
| RSD (%) | 1 | 0 | 4 | 0 | 5 | 5 | 9 | 6 | 0 | 2 |
| 86LFA5400 | 10 | -2 | 480 | 5.8 | 94 | 200 | 3.5 | 7 | 33 | 84 |
| 87LFA2242A | 7.9 | -2 | 530 | 5.4 | 100 | 160 | 3.8 | 8 | 34 | 81 |
| RSD (%) | 16.6 | 0 | 7 | 5.1 | 4 | 16 | 5.8 | 9 | 2 | 3 |
| 86LFA5418 | 4.3 | -2 | 330 | 7.8 | 67 | 110 | 3.8 | 9 | 32 | 65 |
| 86LFA5434 | 4.4 | -2 | 320 | 7.9 | 61 | 110 | 3.9 | 9 | 30 | 64 |
| RSD (%) | 1.6 | 0 | 2 | 0.9 | 7 | 0 | 1.8 | 0 | 5 | 1 |
| ML980039 | 30 | -2 | 360 | 7.3 | 52 | 400 | 2.6 | 8 | 28 | 62 |
| ML980030A | 30 | 2 | 340 | 6.8 | 50 | 350 | 2.5 | 8 | 26 | 64 |
| RSD (%) | 0 | 47 | 4 | 5.0 | 3 | 9 | 2.8 | 0 | 5 | 2 |

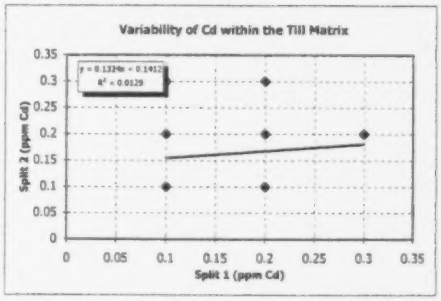
| Element | Sb | Sc | Sm | Na | Ta | Tb | Th | U | Yb | Zr |
|---|---|---|---|---|---|---|---|---|---|---|
| Units | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm |
| S12 | 0.4 | 12 | 4.3 | 1.7 | 1.3 | -0.5 | 8.4 | 2.4 | 2 | 350 |
| T15 | 0.4 | 11 | 4.3 | 1.7 | 1.3 | 0.6 | 7.9 | 2.2 | 2 | 260 |
| RSD (%) | 0.0 | 6 | 0.0 | 0.0 | 0.0 | 58.2 | 4.3 | 6.1 | 0 | 21 |
| Q11 | 0.3 | 11 | 3.0 | 1.2 | 1.3 | -0.5 | 7.8 | 2.2 | 1 | -200 |
| 85LFA0519 | 0.3 | 12 | 2.9 | 1.2 | 1.3 | -0.5 | 7.9 | 2.0 | 2 | 340 |
| RSD (%) | 0.0 | 6 | 2.4 | 0.0 | 0.0 | 0.0 | 0.9 | 6.7 | 47 | 77 |
| T10 | 0.4 | 12 | 4.2 | 1.5 | 0.9 | 0.7 | 8.7 | 2.5 | 2 | 390 |
| 87LFA2039 | 0.5 | 12 | 4.4 | 1.4 | 1.4 | -0.5 | 8.9 | 2.7 | 2 | 340 |
| RSD (%) | 15.7 | 0 | 3.3 | 4.9 | 30.7 | 67.0 | 1.6 | 5.4 | 0 | 10 |
| R14 | 0.5 | 12 | 3.9 | 1.3 | 0.9 | 0.7 | 9.1 | 2.2 | 2 | 320 |
| 87LFA2016A | 0.6 | 11 | 3.9 | 1.3 | 1.2 | 0.7 | 9.2 | 2.4 | 2 | 340 |
| RSD (%) | 12.9 | 6 | 0.0 | 0.0 | 20.2 | 0.0 | 0.8 | 6.1 | 0 | 4 |
| 86LFA5400 | 1.1 | 15 | 4.3 | 1.3 | 1.2 | 0.6 | 10 | 2.4 | 2 | 530 |
| 87LFA2242A | 0.9 | 14 | 4.7 | 1.5 | 1.0 | 0.8 | 10 | 2.6 | 2 | 270 |
| RSD (%) | 14.1 | 5 | 6.3 | 10.1 | 12.9 | 20.2 | 0.0 | 5.7 | 0 | 46 |
| 86LFA5418 | 0.6 | 13 | 4.6 | 1.5 | 1.2 | 0.8 | 7.6 | 2.5 | 3 | 440 |
| 86LFA5434 | 0.6 | 13 | 4.5 | 1.4 | 1.5 | 0.7 | 7.4 | 2.5 | 2 | 420 |
| RSD (%) | 0.0 | 0 | 1.6 | 4.9 | 15.7 | 9.4 | 1.9 | 0.0 | 28 | 3 |
| ML980039 | 1.6 | 12 | 4.2 | 1.2 | 0.9 | 0.7 | 7.8 | 2.5 | 2 | -200 |
| ML980030A | 1.6 | 11 | 4.2 | 1.1 | 1.0 | 0.9 | 7.5 | 2.5 | 1 | 370 |
| RSD (%) | 0.0 | 6 | 0.0 | 6.1 | 7.4 | 17.7 | 2.8 | 0.0 | 47 | 81 |

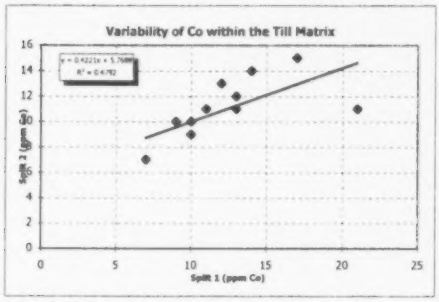
APPENDIX V: Table VIII cont'd - Geochemistry of Lab Duplicates for Selected Elements - INAA

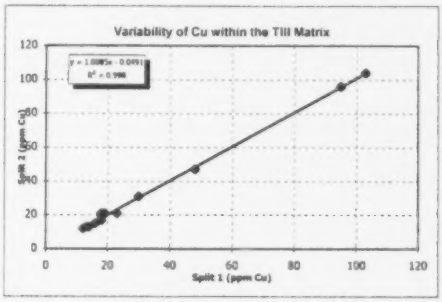
| Instrumental Neutron Activation Analysis (INAA) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Element** | **As** | **Au** | **Ba** | **Br** | **Ce** | **Cr** | **Cs** | **Hf** | **La** | **Rb** |
| **Units** | ppm | ppb | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| **ML980065** | 7.6 | -2 | 440 | 13 | 73 | 200 | 3.2 | 10 | 33 | 75 |
| **ML980060A** | 7.8 | -2 | 400 | 13 | 67 | 170 | 3.3 | 9 | 31 | 74 |
| **RSD (%)** | **1.8** | **0** | **7** | **0** | **6** | **11** | **2.2** | **7** | **4** | **1** |
| **ML980105** | 14 | 4 | 430 | 22 | 86 | 170 | 2.8 | 9 | 31 | 77 |
| **ML980100A** | 14 | 5 | 390 | 21 | 80 | 190 | 3.0 | 8 | 33 | 69 |
| **RSD (%)** | **0** | **16** | **7** | **3** | **5** | **8** | **4.9** | **8** | **4** | **8** |
| **MP990006** | 5.8 | -2 | 330 | 11 | 64 | 170 | 1.9 | 12 | 30 | 69 |
| **MP990057** | 4.6 | -2 | 360 | 11 | 69 | 180 | 1.8 | 12 | 31 | 65 |
| **RSD (%)** | **16.3** | **0** | **6** | **0** | **5** | **4** | **3.8** | **0** | **2** | **4** |
| **MP990042** | 5.0 | -2 | 310 | 23 | 91 | 120 | 2.7 | 16 | 35 | 62 |
| **MP990059** | 5.3 | -2 | 290 | 23 | 92 | 130 | 2.2 | 16 | 35 | 66 |
| **RSD (%)** | **4.1** | **0** | **5** | **0** | **1** | **6** | **14.4** | **0** | **0** | **4** |
| **MP990054** | 6.7 | -2 | 310 | 10 | 81 | 150 | 2.3 | 13 | 30 | 64 |
| **MP990071** | 6.7 | -2 | 300 | 10 | 81 | 160 | 2.1 | 13 | 30 | 60 |
| **RSD (%)** | **0.0** | **0** | **2** | **0** | **0** | **5** | **6.4** | **0** | **0** | **5** |
| **MP990024** | 16 | -2 | 320 | 12 | 87 | 190 | 4.4 | 8 | 22 | 71 |
| **MP990072** | 16 | 4 | 310 | 11 | 81 | 230 | 4.8 | 8 | 24 | 72 |
| **RSD (%)** | **0** | **85** | **2** | **6** | **5** | **13** | **6.1** | **0** | **6** | **1** |
| **Element** | **Sb** | **Sc** | **Sm** | **Na** | **Ta** | **Tb** | **Th** | **U** | **Yb** | **Zr** |
| **Units** | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm |
| **ML980065** | 0.5 | 14 | 4.4 | 1.9 | 0.9 | 0.7 | 9.5 | 2.6 | 2 | 370 |
| **ML980060A** | 0.5 | 13 | 4.2 | 1.7 | 1.0 | 0.8 | 8.8 | 2.5 | 2 | 210 |
| **RSD (%)** | **0.0** | **5** | **3.3** | **7.9** | **7.4** | **9.4** | **5.4** | **2.8** | **0** | **39** |
| **ML980105** | 0.6 | 12 | 5.1 | 1.6 | 1.2 | 1.0 | 10.0 | 2.6 | 1 | -200 |
| **ML980100A** | 0.6 | 12 | 4.9 | 1.6 | 0.9 | 0.9 | 9.2 | 2.6 | 2 | 260 |
| **RSD (%)** | **0.0** | **0** | **2.8** | **0.0** | **20.2** | **7.4** | **5.9** | **0.0** | **47** | **63** |
| **MP990006** | 0.5 | 9 | 3.9 | 1.6 | 0.8 | 0.9 | 7.8 | 2.3 | 3 | 530 |
| **MP990057** | 0.5 | 9 | 4.0 | 1.7 | 1.0 | 0.7 | 7.8 | 2.4 | 3 | 390 |
| **RSD (%)** | **0.0** | **4** | **1.8** | **4.3** | **15.7** | **17.7** | **0.0** | **3.0** | **0** | **22** |
| **MP990042** | 0.4 | 9 | 5.0 | 1.4 | 1.2 | -0.5 | 9.1 | 2.8 | 5 | 460 |
| **MP990059** | 0.4 | 9 | 5.0 | 1.4 | 1.3 | 1.0 | 8.9 | 2.7 | 5 | 590 |
| **RSD (%)** | **0.0** | **1** | **0.0** | **0.0** | **5.7** | **84.9** | **1.6** | **2.6** | **0** | **18** |
| **MP990054** | 0.5 | 12 | 4.0 | 1.5 | 1.2 | 0.8 | 8.0 | 2.5 | 4 | 400 |
| **MP990071** | 0.6 | 12 | 4.1 | 1.5 | 1.1 | -0.5 | 8.3 | 2.4 | 4 | 590 |
| **RSD (%)** | **12.9** | **0** | **1.7** | **0.0** | **6.1** | **74.1** | **2.6** | **2.9** | **0** | **27** |
| **MP990024** | 1.4 | 10 | 3.0 | 1.3 | 1.3 | 0.6 | 7.8 | 2.3 | 2 | -200 |
| **MP990072** | 1.5 | 12 | 3.1 | 1.5 | 1.0 | -0.5 | 7.6 | 2.3 | 3 | 280 |
| **RSD (%)** | **4.9** | **13** | **2.3** | **10.1** | **18.4** | **58.2** | **1.8** | **0.0** | **28** | **67** |

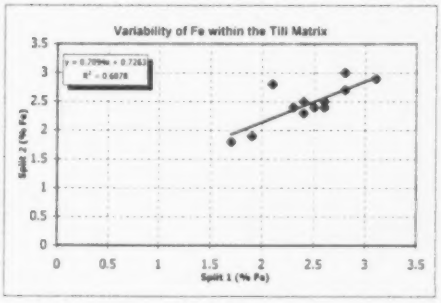
APPENDIX V - Figure I: Graphical Analysis of Lab Duplicates - AAS

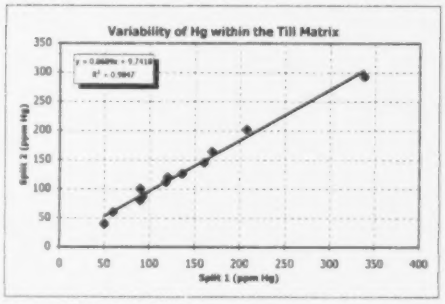


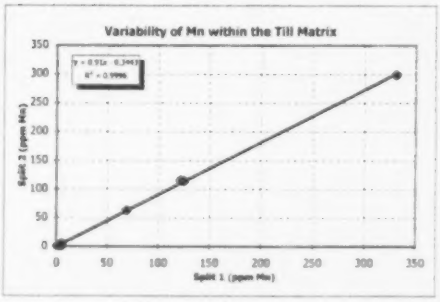



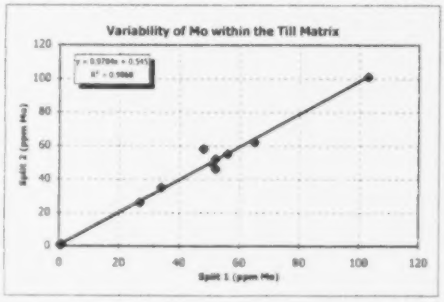



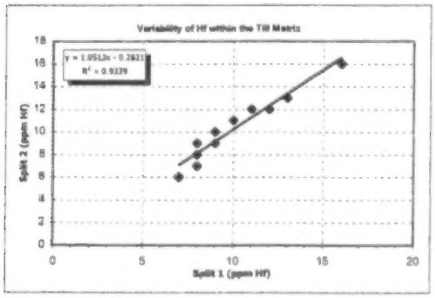



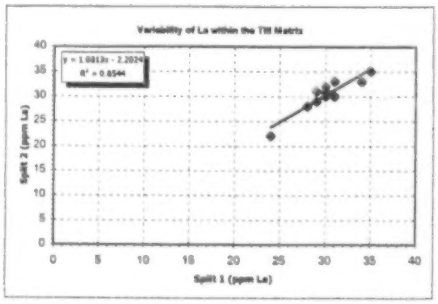



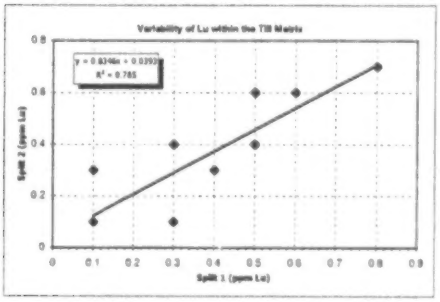



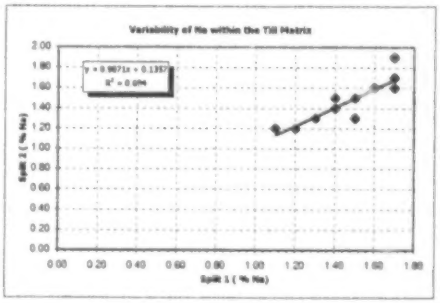



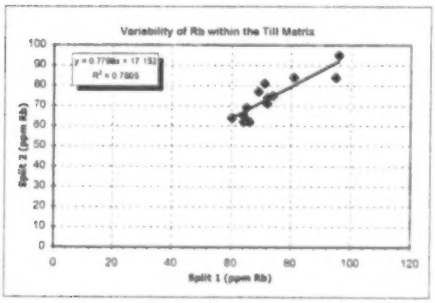
APPENDIX V - Figure I cont'd: Graphical Analysis of Lab Duplicates - AAS

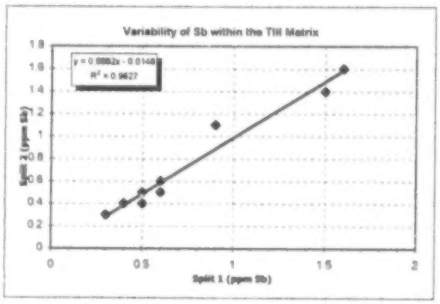


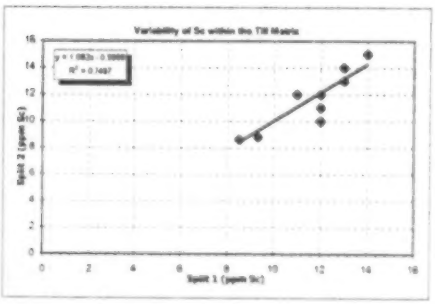



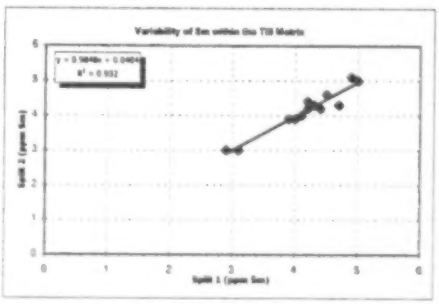



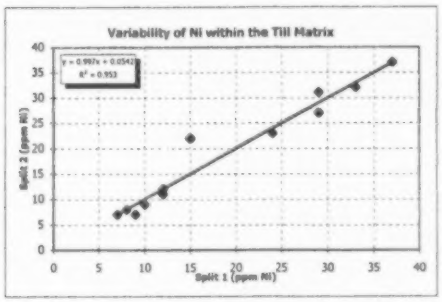



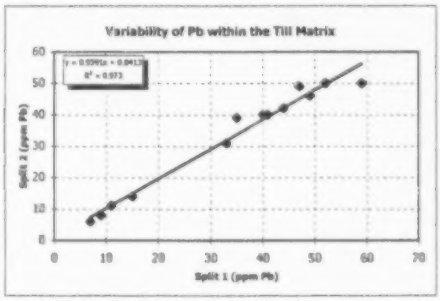



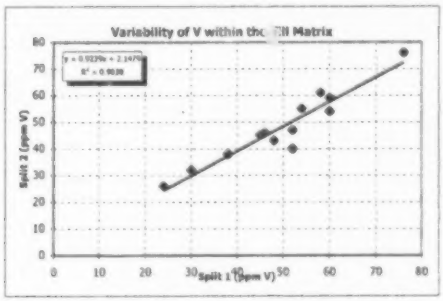



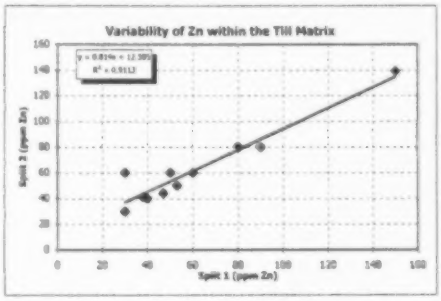



APPENDIX V - Figure I cont'd: Graphical Analysis of Lab Duplicates - AAS

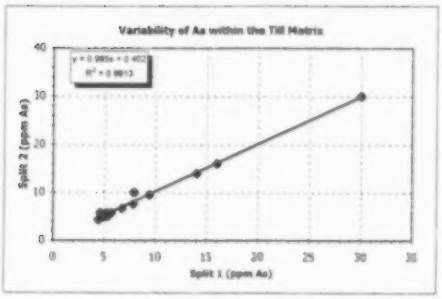


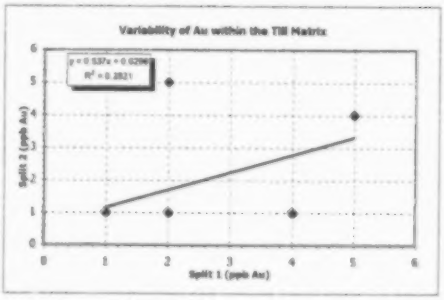



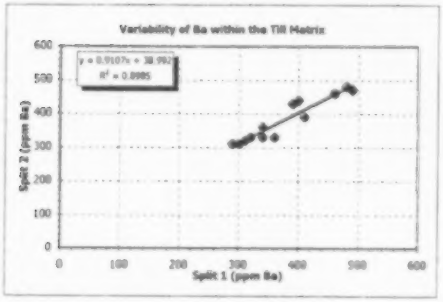



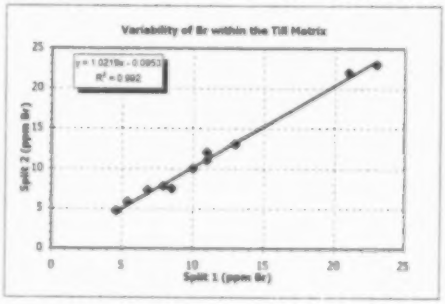



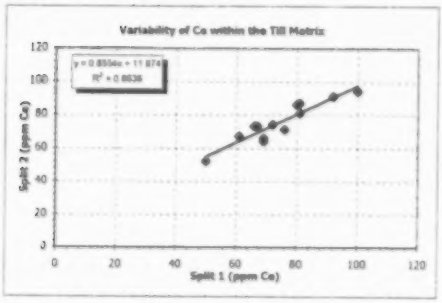
APPENDIX V: Figure II - Graphical Analysis of Lab Duplicates - INAA
(selected elements)

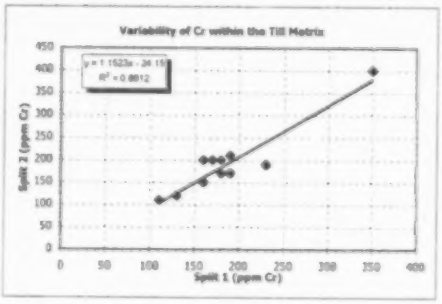


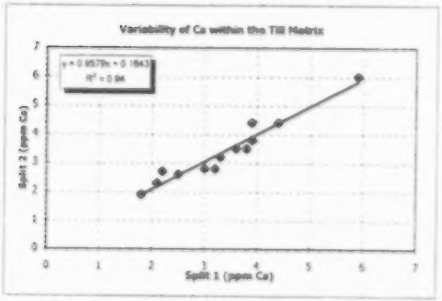



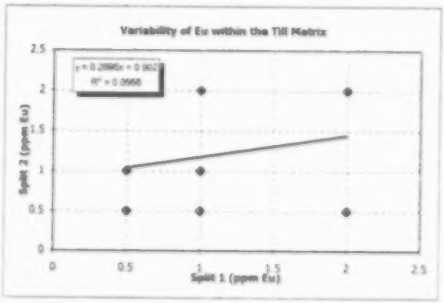



APPENDIX V: Figure II cont'd - Graphical Analysis of Lab Duplicates - INAA
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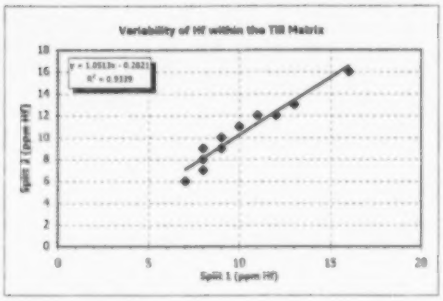
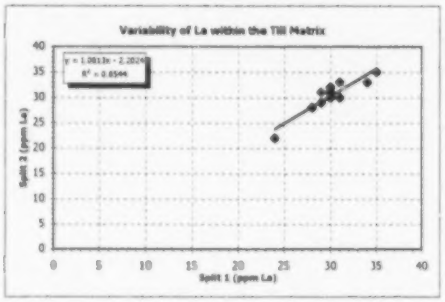
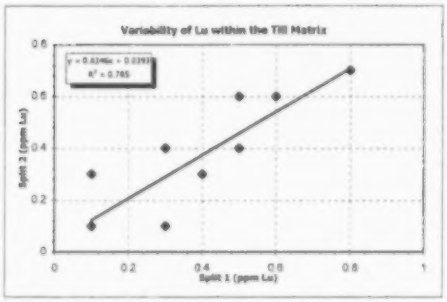
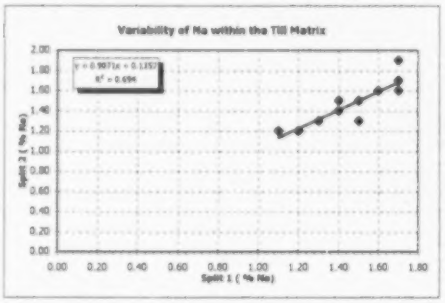
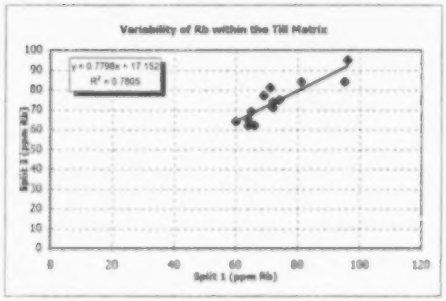
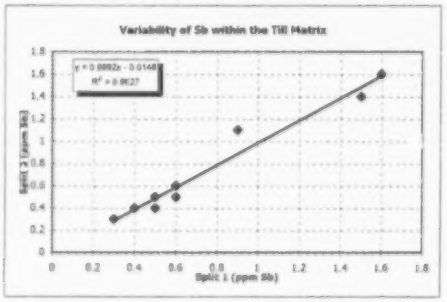


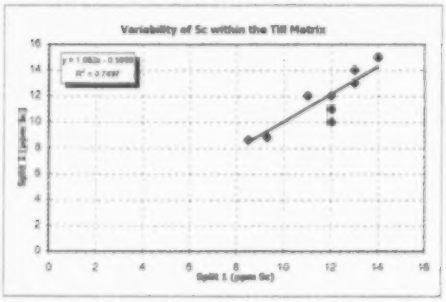



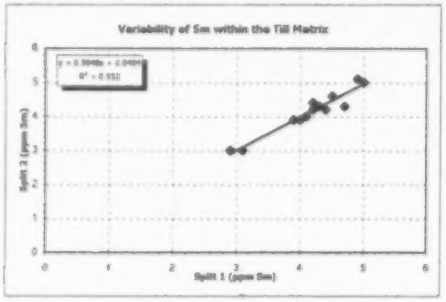



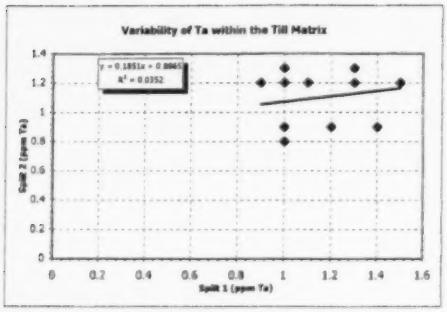



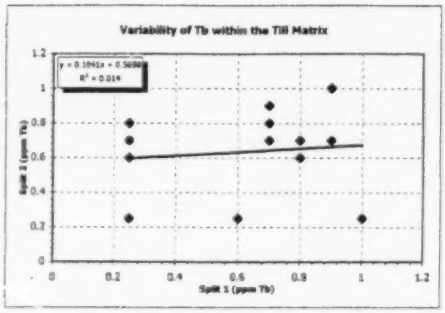



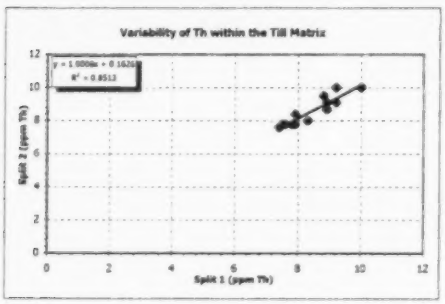



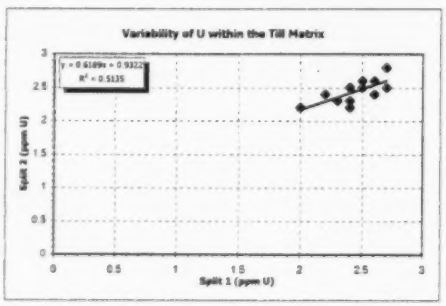



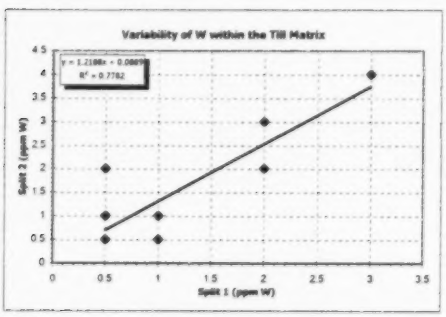
APPENDIX V: Figure II cont'd - Graphical Analysis of Lab Duplicates - INAA
(selected elements)

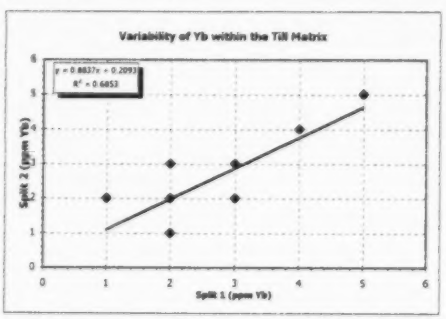


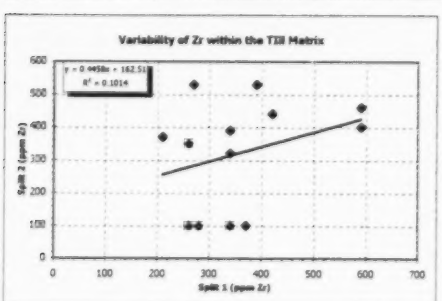



# APPENDIX VI

## STATISTICAL ANALYSES

Geochemical data for till and humus, and till granulometric data were compiled in spreadsheet form and descriptive statistics were performed using Corel® Quattro Pro 9. Median values were used to establish regional background concentrations. Threshold values of two standard deviations from the population median were designated anomalous (Table I, II).

APPENDIX VI: Table I - Descriptive Statistics of Geochemical and Granulometric Data

| | DL | s | mean | med | mode | min | 50% | 75% | 90% | 95% | 98% | max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ag** | 0.5 | 0.35 | 0.2 | 0.2 | 0.1 | 0.1 | 0.2 | 0.2 | 0.5 | 0.9 | 1.35 | 3.1 |
| **As** | 2 | 8.51 | 10.9 | 8.2 | 10 | 1.2 | 8.15 | 11 | 19 | 25.65 | 40.46 | 69.8 |
| **Au** | 2 | 2.89 | -0.4 | 1 | 1 | 1 | 1 | 1 | 4 | 5 | 12 | 28 |
| **Ba** | 20 | 106.59 | 375.4 | 370 | 370 | 88 | 360 | 410 | 463 | 496.5 | 549.2 | 1600 |
| **Br** | 0.5 | 11.69 | 13.8 | 10 | 16 | 0.9 | 10 | 16 | 27 | 41 | 50.02 | 76.90 |
| **Cd** | 0.2 | 0.15 | 0.1 | 0.2 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.4 | 0.55 | 1.90 |
| **Ce** | 1 | 32.12 | 83.3 | 78 | 110 | 16 | 77.5 | 93 | 110 | 136.5 | 174.6 | 300 |
| **Co** | 0.1 | 5.82 | 12.2 | 11 | 10 | 3 | 11 | 13 | 18 | 20 | 27.46 | 74 |
| **Cr** | 1 | 75.72 | 188.7 | 180 | 170 | 23 | 170 | 210 | 260 | 320 | 404.6 | 650 |
| **Cs** | 0.2 | 2.45 | 3.8 | 3.1 | 2.6 | 0.8 | 3.1 | 4.5 | 5.8 | 6.76 | 8.27 | 36 |
| **Cu** | 1 | 69.93 | 45.4 | 21 | 13 | 7 | 21 | 41 | 93.9 | 187.15 | 285.38 | 630 |
| **Eu** | 1 | 0.77 | 1.0 | 1 | 2 | 0.5 | 1 | 2 | 2 | 3 | 3 | 5 |
| **Fe** | 0.02 | 1 | 2.8 | 2.6 | 1.9 | 1 | 2.6 | 3.3 | 4 | 4.56 | 5.45 | 10.8 |
| **Hf** | 0.5 | 3.31 | 9.3 | 9 | 7 | 2 | 9 | 12 | 13 | 15 | 16 | 22 |
| **Hg** | 5 | 28.28 | 65.8 | 60 | 60 | 20 | 60 | 80 | 100 | 120 | 140 | 170 |
| **Ir** | 50 | 0 | 25.0 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| **La** | 0.5 | 9.16 | 32.3 | 31 | 29 | 6 | 31 | 35 | 40 | 47 | 57.92 | 90 |
| **Lu** | 0.2 | 0.17 | 0.3 | 0.3 | 0.3 | 0.1 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 1 |
| **Mn** | 2 | 222.83 | 235.7 | 169 | 110 | 57 | 169 | 281.25 | 403 | 545.45 | 793.94 | 2380 |
| **Mo** | 1 | 4.43 | 2.0 | 1 | 1 | 0.5 | 1 | 2 | 4 | 6.00 | 12.92 | 55.00 |
| **Na** | 0.01 | 0.36 | 1.4 | 1.4 | 1.6 | 0.21 | 1.4 | 1.6 | 1.8 | 1.9 | 1.9 | 2.51 |
| **Ni** | 10 | 24.9 | 47.8 | 43.5 | 33 | 5 | 43.5 | 60 | 78 | 86 | 99.92 | 255 |
| **Pb** | 1 | 12.41 | 15.1 | 12 | 11 | 2 | 12 | 16.25 | 24 | 34 | 45.46 | 133 |
| **Rb** | 5 | 20.81 | 75.0 | 72 | 65 | 2.5 | 72 | 86 | 100 | 110.00 | 124.60 | 160 |
| **Sb** | 0.1 | 0.41 | 0.8 | 0.7 | 0.7 | 0.1 | 0.7 | 0.9 | 1.1 | 1.4 | 2.08 | 3.3 |
| **Sc** | 0.1 | 3.8 | 13.0 | 12 | 11 | 2.7 | 12 | 14 | 17 | 18.65 | 26.11 | 35.4 |
| **Se** | 5 | 0 | -5.0 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| **Sm** | 0.1 | 1.77 | 4.9 | 4.5 | 4.2 | 0.9 | 4.45 | 5.2 | 6.66 | 8.46 | 10.64 | 13.8 |
| **Sn** | 100 | 5.57 | 50.0 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 150 |
| **Ta** | 0.5 | 0.31 | 1.1 | 1.1 | 1.1 | 0.25 | 1.1 | 1.3 | 1.5 | 1.60 | 1.80 | 2.60 |
| **Tb** | 0.5 | 0.31 | 0.6 | 0.7 | 0.6 | 0.25 | 0.7 | 0.8 | 1 | 1.2 | 1.45 | 2 |
| **Te** | 10 | 0 | 5.0 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| **Th** | 0.5 | 1.97 | 9.0 | 8.8 | 10 | 2 | 8.7 | 10 | 11 | 11.65 | 14 | 25.2 |
| **U** | 0.5 | 0.53 | 2.6 | 2.5 | 2.4 | 0.6 | 2.5 | 2.7 | 3 | 3.36 | 4.35 | 5.5 |
| **V** | 1 | 19.73 | 47.5 | 43 | 40 | 21 | 43 | 52 | 66.6 | 80 | 102.22 | 200 |
| **W** | 1 | 4.44 | 1.2 | 1 | 0.5 | 0.5 | 1 | 2 | 3 | 5 | 10.92 | 67 |
| **Yb** | 1 | 0.96 | 2.3 | 2 | 2 | 0.5 | 2 | 3 | 3.3 | 4.00 | 5.00 | 7.00 |
| **Zn** | 1 | 45.16 | 70.1 | 59 | 45 | 23 | 59 | 74 | 105 | 148.25 | 232.92 | 347 |
| **Zr** | 200 | 186.98 | 220.8 | 330 | 100 | 100 | 320 | 450 | 570 | 616.50 | 720 | 940 |
| **sand** | N/A | 9.1 | 49 | 48 | 52 | 27 | 48 | 54 | 61 | 65 | 72.4 | 83 |
| **silt** | N/A | 8.2 | 41 | 43 | 44 | 12 | 42 | 46 | 50 | 52.5 | 55 | 63 |
| **clay** | N/A | 4.8 | 9 | 8 | 8 | 1 | 8 | 11 | 16 | 18 | 20.2 | 35 |

APPENDIX VI: Table II - Descriptive Statistics of Humus Geochemical Data

| | s | mean | med | mode | min | 50% | 75% | 90% | 95% | 98% | max | EF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ag** | 1.5 | 1.2 | 0.8 | 0.4 | 0.2 | 0.8 | 1.4 | 2.1 | 3.0 | 4.0 | 14.5 | **4.7** |
| **As** | 1.9 | 13 | 2.9 | 2.4 | 0.8 | 2.9 | 3.9 | 5.0 | 6.1 | 9.5 | 13 | |
| **Au** | 2 | 6 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 6 | |
| **Ba** | 96 | 580 | 160 | 150 | 52 | 160 | 200 | 290 | 370 | 490 | 580 | |
| **Br** | 4.8 | 37 | 7.3 | 10 | 3.7 | 7.3 | 9.2 | 12.2 | 16.0 | 23.0 | 37 | |
| **Cd** | 0.9 | 1.1 | 0.8 | 0.6 | 0.2 | 0.8 | 1.2 | 1.8 | 2.3 | 2.8 | 7.3 | **6.2** |
| **Ce** | 17 | 120 | 11 | 3 | 3 | 11 | 15 | 22 | 27 | 74 | 120 | |
| **Co** | 5 | 2 | 2 | 1 | 1 | 2 | 3 | 5 | 9 | 12 | 27 | |
| **Cr** | 43 | 180 | 25 | 10 | 10 | 25 | 47 | 77 | 95 | 120 | 180 | |
| **Cs** | 0.7 | 2.4 | 0.7 | 0.25 | 0.25 | 0.7 | 1 | 1.4 | 1.5 | 1.9 | 2.4 | |
| **Cu** | 28 | 18 | 13 | 10 | 7 | 13 | 17 | 20 | 30 | 66 | 288 | |
| **Eu** | 1 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 8 | |
| **Fe** | 0.36 | 0.50 | 0.45 | 0.46 | 0.12 | 0.45 | 0.65 | 1.10 | 1.30 | 1.50 | 2.00 | |
| **Hf** | 2 | 6 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 4 | 6 | |
| **Hg** | 75 | 273 | 270 | 230 | 140 | 270 | 320 | 380 | 400 | 435 | 450 | **4** |
| **Ir** | 0 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | |
| **La** | 15 | 140 | 6 | 3 | 1 | 6 | 8 | 13 | 17 | 43 | 140 | |
| **Lu** | 0.2 | 1.4 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.3 | 0.3 | 0.3 | 1.4 | |
| **Mn** | 1598 | 1302 | 586 | 73 | 24 | 586 | 1820 | 3664 | 5132 | 5551 | 7290 | **9** |
| **Mo** | 5 | 3 | 2 | 2 | 1 | 2 | 3 | 4 | 8 | 9 | 50 | |
| **Na** | 0.1 | 0.71 | 0.16 | 0.15 | 0.03 | 0.16 | 0.27 | 0.4 | 0.5 | 0.6 | 0.71 | |
| **Ni** | 4 | 10 | 8 | 7 | 4 | 8 | 11 | 15 | 20 | 22 | 28 | |
| **Pb** | 25 | 67 | 64 | 64 | 15 | 64 | 79 | 92 | 99 | 120 | 220 | **6** |
| **Rb** | 11 | 63 | 15 | 10 | 3 | 15 | 22 | 31 | 36 | 46 | 63 | |
| **Sb** | 0.2 | 1.6 | 0.9 | 0.9 | 0.2 | 0.9 | 1.1 | 1.1 | 1.3 | 1.4 | 1.6 | |
| **Sc** | 1.7 | 8.4 | 2 | 2 | 0.4 | 2 | 3.4 | 5.3 | 6.0 | 6.7 | 8.4 | |
| **Se** | 0 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | |
| **Sm** | 2.6 | 25.8 | 0.6 | 0.4 | 0.2 | 0.6 | 1.1 | 1.6 | 2.3 | 7.2 | 25.8 | |
| **Sn** | 0 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | |
| **Ta** | 0.2 | 0.6 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.6 | 0.6 | |
| **Tb** | 0.4 | 3.1 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.6 | 3.1 | |
| **Te** | 0 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | |
| **Th** | 0.8 | 3.3 | 1.1 | 1.1 | 0.3 | 1.1 | 1.8 | 2.5 | 2.9 | 3.1 | 3.3 | |
| **U** | 0.5 | 2.6 | 0.5 | 0.4 | 0.1 | 0.5 | 0.8 | 1.2 | 1.4 | 1.5 | 2.6 | |
| **V** | 7 | 20 | 19 | 10 | 9 | 19 | 24 | 27 | 33 | 40 | 44 | |
| **W** | 2 | 20 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 20 | |
| **Yb** | 1 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 6 | |
| **Zn** | 56 | 108 | 94 | 61 | 37 | 94 | 120 | 194 | 235 | 263 | 309 | **2** |
| **Zr** | 80 | 250 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 218 | 250 | |

**Note: EF represents Enrichment Factor: [humus]/[till]**

APPENDIX VI: Table I - Descriptive Statistics of Geochemical and Granulometric Data

| | DL | s | mean | med | mode | min | 50% | 75% | 90% | 95% | 98% | max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ag** | 0.5 | 0.35 | 0.2 | 0.2 | 0.1 | 0.1 | 0.2 | 0.2 | 0.5 | 0.9 | 1.35 | 3.1 |
| **As** | 2 | 8.51 | 10.9 | 8.2 | 10 | 1.2 | 8.15 | 11 | 19 | 25.65 | 40.46 | 69.8 |
| **Au** | 2 | 2.89 | -0.4 | 1 | 1 | 1 | 1 | 1 | 4 | 5 | 12 | 28 |
| **Ba** | 20 | 106.59 | 375.4 | 370 | 370 | 88 | 360 | 410 | 463 | 496.5 | 549.2 | 1600 |
| **Br** | 0.5 | 11.69 | 13.8 | 10 | 16 | 0.9 | 10 | 16 | 27 | 41 | 50.02 | 76.90 |
| **Cd** | 0.2 | 0.15 | 0.1 | 0.2 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.4 | 0.55 | 1.90 |
| **Ce** | 1 | 32.12 | 83.3 | 78 | 110 | 16 | 77.5 | 93 | 110 | 136.5 | 174.6 | 300 |
| **Co** | 0.1 | 5.82 | 12.2 | 11 | 10 | 3 | 11 | 13 | 18 | 20 | 27.46 | 74 |
| **Cr** | 1 | 75.72 | 188.7 | 180 | 170 | 23 | 170 | 210 | 260 | 320 | 404.6 | 650 |
| **Cs** | 0.2 | 2.45 | 3.8 | 3.1 | 2.6 | 0.8 | 3.1 | 4.5 | 5.8 | 6.76 | 8.27 | 36 |
| **Cu** | 1 | 69.93 | 45.4 | 21 | 13 | 7 | 21 | 41 | 93.9 | 187.15 | 285.38 | 630 |
| **Eu** | 1 | 0.77 | 1.0 | 1 | 2 | 0.5 | 1 | 2 | 2 | 3 | 3 | 5 |
| **Fe** | 0.02 | 1 | 2.8 | 2.6 | 1.9 | 1 | 2.6 | 3.3 | 4 | 4.56 | 5.45 | 10.8 |
| **Hf** | 0.5 | 3.31 | 9.3 | 9 | 7 | 2 | 9 | 12 | 13 | 15 | 16 | 22 |
| **Hg** | 5 | 28.28 | 65.8 | 60 | 60 | 20 | 60 | 80 | 100 | 120 | 140 | 170 |
| **Ir** | 50 | 0 | 25.0 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| **La** | 0.5 | 9.16 | 32.3 | 31 | 29 | 6 | 31 | 35 | 40 | 47 | 57.92 | 90 |
| **Lu** | 0.2 | 0.17 | 0.3 | 0.3 | 0.3 | 0.1 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 1 |
| **Mn** | 2 | 222.83 | 235.7 | 169 | 110 | 57 | 169 | 281.25 | 403 | 545.45 | 793.94 | 2380 |
| **Mo** | 1 | 4.43 | 2.0 | 1 | 1 | 0.5 | 1 | 2 | 4 | 6.00 | 12.92 | 55.00 |
| **Na** | 0.01 | 0.36 | 1.4 | 1.4 | 1.6 | 0.21 | 1.4 | 1.6 | 1.8 | 1.9 | 1.9 | 2.51 |
| **Ni** | 10 | 24.9 | 47.8 | 43.5 | 33 | 5 | 43.5 | 60 | 78 | 86 | 99.92 | 255 |
| **Pb** | 1 | 12.41 | 15.1 | 12 | 11 | 2 | 12 | 16.25 | 24 | 34 | 45.46 | 133 |
| **Rb** | 5 | 20.81 | 75.0 | 72 | 65 | 2.5 | 72 | 86 | 100 | 110.00 | 124.60 | 160 |
| **Sb** | 0.1 | 0.41 | 0.8 | 0.7 | 0.7 | 0.1 | 0.7 | 0.9 | 1.1 | 1.4 | 2.08 | 3.3 |
| **Sc** | 0.1 | 3.8 | 13.0 | 12 | 11 | 2.7 | 12 | 14 | 17 | 18.65 | 26.11 | 35.4 |
| **Se** | 5 | 0 | -5.0 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| **Sm** | 0.1 | 1.77 | 4.9 | 4.5 | 4.2 | 0.9 | 4.45 | 5.2 | 6.66 | 8.46 | 10.64 | 13.8 |
| **Sn** | 100 | 5.57 | 50.0 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 150 |
| **Ta** | 0.5 | 0.31 | 1.1 | 1.1 | 1.1 | 0.25 | 1.1 | 1.3 | 1.5 | 1.60 | 1.80 | 2.60 |
| **Tb** | 0.5 | 0.31 | 0.6 | 0.7 | 0.6 | 0.25 | 0.7 | 0.8 | 1 | 1.2 | 1.45 | 2 |
| **Te** | 10 | 0 | 5.0 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| **Th** | 0.5 | 1.97 | 9.0 | 8.8 | 10 | 2 | 8.7 | 10 | 11 | 11.65 | 14 | 25.2 |
| **U** | 0.5 | 0.53 | 2.6 | 2.5 | 2.4 | 0.6 | 2.5 | 2.7 | 3 | 3.36 | 4.35 | 5.5 |
| **V** | 1 | 19.73 | 47.5 | 43 | 40 | 21 | 43 | 52 | 66.6 | 80 | 102.22 | 200 |
| **W** | 1 | 4.44 | 1.2 | 1 | 0.5 | 0.5 | 1 | 2 | 3 | 5 | 10.92 | 67 |
| **Yb** | 1 | 0.96 | 2.3 | 2 | 2 | 0.5 | 2 | 3 | 3.3 | 4.00 | 5.00 | 7.00 |
| **Zn** | 1 | 45.16 | 70.1 | 59 | 45 | 23 | 59 | 74 | 105 | 148.25 | 232.92 | 347 |
| **Zr** | 200 | 186.98 | 220.8 | 330 | 100 | 100 | 320 | 450 | 570 | 616.50 | 720 | 940 |
| **sand** | N/A | 9.1 | 49 | 48 | 52 | 27 | 48 | 54 | 61 | 65 | 72.4 | 83 |
| **silt** | N/A | 8.2 | 41 | 43 | 44 | 12 | 42 | 46 | 50 | 52.5 | 55 | 63 |
| **clay** | N/A | 4.8 | 9 | 8 | 8 | 1 | 8 | 11 | 16 | 18 | 20.2 | 35 |

APPENDIX VI: Table II - Descriptive Statistics of Humus Geochemical Data

| | s | mean | med | mode | min | 50% | 75% | 90% | 95% | 98% | max | EF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ag** | 1.5 | 1.2 | 0.8 | 0.4 | 0.2 | 0.8 | 1.4 | 2.1 | 3.0 | 4.0 | 14.5 | **4.7** |
| **As** | 1.9 | 13 | 2.9 | 2.4 | 0.8 | 2.9 | 3.9 | 5.0 | 6.1 | 9.5 | 13 | |
| **Au** | 2 | 6 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 6 | |
| **Ba** | 96 | 580 | 160 | 150 | 52 | 160 | 200 | 290 | 370 | 490 | 580 | |
| **Br** | 4.8 | 37 | 7.3 | 10 | 3.7 | 7.3 | 9.2 | 12.2 | 16.0 | 23.0 | 37 | |
| **Cd** | 0.9 | 1.1 | 0.8 | 0.6 | 0.2 | 0.8 | 1.2 | 1.8 | 2.3 | 2.8 | 7.3 | **6.2** |
| **Ce** | 17 | 120 | 11 | 3 | 3 | 11 | 15 | 22 | 27 | 74 | 120 | |
| **Co** | 5 | 2 | 2 | 1 | 1 | 2 | 3 | 5 | 9 | 12 | 27 | |
| **Cr** | 43 | 180 | 25 | 10 | 10 | 25 | 47 | 77 | 95 | 120 | 180 | |
| **Cs** | 0.7 | 2.4 | 0.7 | 0.25 | 0.25 | 0.7 | 1 | 1.4 | 1.5 | 1.9 | 2.4 | |
| **Cu** | 28 | 18 | 13 | 10 | 7 | 13 | 17 | 20 | 30 | 66 | 288 | |
| **Eu** | 1 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 8 | |
| **Fe** | 0.36 | 0.50 | 0.45 | 0.46 | 0.12 | 0.45 | 0.65 | 1.10 | 1.30 | 1.50 | 2.00 | |
| **Hf** | 2 | 6 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 4 | 6 | |
| **Hg** | 75 | 273 | 270 | 230 | 140 | 270 | 320 | 380 | 400 | 435 | 450 | **4** |
| **Ir** | 0 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | |
| **La** | 15 | 140 | 6 | 3 | 1 | 6 | 8 | 13 | 17 | 43 | 140 | |
| **Lu** | 0.2 | 1.4 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.3 | 0.3 | 0.3 | 1.4 | |
| **Mn** | 1598 | 1302 | 586 | 73 | 24 | 586 | 1820 | 3664 | 5132 | 5551 | 7290 | **9** |
| **Mo** | 5 | 3 | 2 | 2 | 1 | 2 | 3 | 4 | 8 | 9 | 50 | |
| **Na** | 0.1 | 0.71 | 0.16 | 0.15 | 0.03 | 0.16 | 0.27 | 0.4 | 0.5 | 0.6 | 0.71 | |
| **Ni** | 4 | 10 | 8 | 7 | 4 | 8 | 11 | 15 | 20 | 22 | 28 | |
| **Pb** | 25 | 67 | 64 | 64 | 15 | 64 | 79 | 92 | 99 | 120 | 220 | **6** |
| **Rb** | 11 | 63 | 15 | 10 | 3 | 15 | 22 | 31 | 36 | 46 | 63 | |
| **Sb** | 0.2 | 1.6 | 0.9 | 0.9 | 0.2 | 0.9 | 1.1 | 1.1 | 1.3 | 1.4 | 1.6 | |
| **Sc** | 1.7 | 8.4 | 2 | 2 | 0.4 | 2 | 3.4 | 5.3 | 6.0 | 6.7 | 8.4 | |
| **Se** | 0 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | |
| **Sm** | 2.6 | 25.8 | 0.6 | 0.4 | 0.2 | 0.6 | 1.1 | 1.6 | 2.3 | 7.2 | 25.8 | |
| **Sn** | 0 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | |
| **Ta** | 0.2 | 0.6 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.6 | 0.6 | |
| **Tb** | 0.4 | 3.1 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.6 | 3.1 | |
| **Te** | 0 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | |
| **Th** | 0.8 | 3.3 | 1.1 | 1.1 | 0.3 | 1.1 | 1.8 | 2.5 | 2.9 | 3.1 | 3.3 | |
| **U** | 0.5 | 2.6 | 0.5 | 0.4 | 0.1 | 0.5 | 0.8 | 1.2 | 1.4 | 1.5 | 2.6 | |
| **V** | 7 | 20 | 19 | 10 | 9 | 19 | 24 | 27 | 33 | 40 | 44 | |
| **W** | 2 | 20 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 20 | |
| **Yb** | 1 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 6 | |
| **Zn** | 56 | 108 | 94 | 61 | 37 | 94 | 120 | 194 | 235 | 263 | 309 | **2** |
| **Zr** | 80 | 250 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 218 | 250 | |

**Note: EF represents Enrichment Factor: [humus]/[till]**